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PART III

ABSTRACTS

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PART III—ABSTRACTS

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SECTION OF MATHEMATICS

PRESIDENT : DR. S. CHOWLA

Abstracts

1. Bending of a $\lfloor$ — Plate.

B. R. SETH, Delhi.

Bending of rectilinear plates with supported edges and subjected to uniform pressure has been discussed in two recent papers. Plates with one or more re-entrant angles do not seem to have received any attention. In the present paper we discuss the bending of a $\lfloor$ - plate.

2. On Some Integrals Involving Legendre Functions.

N. G. SHABDE, Jubbulpore.

In the paper 'On two definite Integrals involving Legendre functions' (*Proc. Benares Math. Soc.*. new series, Vol VII. 1945, pp. 51-53), the author has evaluated

$\int_{-1}^{1} (1+z)^{m+n} P_m P_n \, dz$ and $\int_{-1}^{1} (1+z)^p P_n \, dz$ for general values of m, n and p. In this paper these results are still further discussed and some more integrals, specially

$\int_{-1}^{1} (1+z)^p P_m P_n \, dz$, are evaluated.

3. On Real Continuous Solutions of Algebraic Difference Equations (II)

S. M. SHAH, Aligarh.

I have discussed elsewhere ((i) *Bulletin Amer. Math. Soc.* 53, 1947, pp. 548-558; (ii) *Proc. Ind. Sc. Cong*, 1948, abstracts) the upper bounds of solutions of Difference Equations. In this paper I prove

Theorem. *If $y(x)$, a real continuous solution of an algebraic difference equation of the second order, $P(y(x+2), y(x+1), y(x), x)=0$ satisfies the conditions*

$$\log y(x) / \log x \to \infty \quad \text{as} \quad x \to \infty, \quad y(x+h) \geqslant y(x) / e_2(Bx), \quad 0 < h \leqslant 1, \quad x > x_0,$$

B a positive constant, then $y(x) < e_2(Ax)$ for all $x > x_0(A)$ where $A > B$ is a positive constant depending on the given equation.

A general theorem on Difference Equations of order m is also established.

4. The Vector form of an Invariant of Transformation.

K. NAGABHUSHANAM, Waltair.

A transformation of Vectors is completely known if a transformation matrix is given or a triad of vectors a, b, c along with their transforms α, β, γ are given. The invariant *viz.*, of the Trace (or Spur) of the matrix is shown to be

$$ab\ \gamma + bc\ \alpha + ca\ \beta$$

$$abc$$

where each is a triple scalar product.

The author conjectures that it is not possible to express this invariant as a function of only the quarternions aa^{-1}, βb^{-1} and γc^{-1}, and their inverses.

5. On Compressible Fluid Flow.

RAM BALLABH, Lucknow.

The paper discusses the conditions under which the velocity of a compressible fiuid flow will be the vector sum of the velocities of two possible flows. The fluid is assumed to obey Boyle's law. The results obtained include as special cases some of those given by the author in an earlier work. (Superposable Fluid Motions, *Proc. Benares Math. Soc.*, 1940).

6. A Generalisation of Laplace Integral.

R. S. VARMA, Lucknow.

In this paper, a generalisation of Laplace Integral is given, The theory is developed by the help of Whittaker Functions, and involves Stieltjes Integration.

7. A New Theorem for Finding the Factorial Moments of Certain Probability Distributions.

P. V. KRISHNA IYER, New Delhi.

The r-th factoial moment of the Binomial Distribution is $r^{[n}\, c_r p$. This is the expectation of r things with probability p from n objects whose probabilities are either p or $1-p$.

For more complicated distributions the above result may be enunciated as follows :

The r-th factorial moment of a probability distribution is the sum of the expectations of the different ways of obtaining r of the desired combination of events or objects.

This method has been applied for finding the factorial moments of

(1) hypergeometric series.

(2) the probabilities distributions of the number of joins between points of the same or different colours arising from points of k coloms on a lattice.

8. Gauss Points in n-Dimensional Space.

S. R. MANDAN, Kirkee.

There are in all $(n+1)!$ Gauss points. They all lie on a Quadratic-variety W and by $n-r+1$s in $\frac{n+1\ ^{n+1}c\gamma}{n-\gamma+1}$ *i.e.* $\frac{(n+1)^2}{(n-\gamma+1)^2\gamma!}$ $(n-r)$-*flats* $(r=1,2,..\ n-1)$, in particular by n^s in $(n+1)^2$ primes. These primes are faces of two sets of $n+1$ simplexes such that simplexes of one set are mutually perspective from the centroid of one of the given sim- plexes and the primes and of perspectivity pass through the centroid & a $(n-2)$-flat of the 2nd given simplex. The two centroids constitute a pair of conjugate points for W.

9. An Inversion Formula for Generalised Laplace Stieltjes Integral.

K. M. SAKSENA, Saugor.

In a recent paper Dr. R. S. Varma of Lucknow University has given a generalisation of the Laplace Stieltjes Integral involving Whittaker Functions.

I have in this paper investigated an inversion formula different from that given by Dr. Varma.

10. On a Generalisation of the Hankel Transform.

RATAN PRAKASH AGARWAL, Lucknow.

At the last Science Congress at Patna I gave a generalisation of the Hankel Transform by using Maitland's generalised Bessel function. In this paper, I have further developed the theory of this generalised transform.

11. A Note on Hamy's Theorem.

N. L. GHOSH, Calcutta.

M. Hamy in 1889 proved the theorem that a heterogeneous liquid rotating in relative equilibrium about an axis cannot have an ellipsoidal density-distribution. The present note is a proof of the same theorem with a slight generalisation. The interesting point that is brought out here is that the proof does not depend on the form of the potential for a homogeneous ellipsoid. The method followed here does not require the potential function and therefore can be used to test the possibility of other forms of density-distributions. The gravitational field may be due to self-gravitation of the fluid together with an external field obeying certain restrictions.

12. On the Total Relative Strength of some Hausdorff methods equivalent to Convergence.

S. K. BASU, Calcutta.

In this paper, for a given sequence $\{s_n\}$, the transformation

$$\sigma_n = U\alpha\ \{s_n\} \qquad (n=0, 1, 2, ..)$$

is considered, where the matrix $U\alpha$ is defined by

$$U\alpha = \alpha E + (1-\alpha)\, H,$$

E being the identity matrix and H a suitable totally regular Hausdorff matrix. It is proved that, for $\alpha > 0$, $s_n \to l$ implies $\sigma_n \to l$ and conversely. With certain restrictions on the mass function $\phi(t)$ of H, it is proved that, for $\alpha < 0$, $s_n \to l$ implies $\sigma_n \to l$, but the converse is false. The question whether $s_n \to +\infty$ implies $\sigma_n \to +\infty$ and conversely is discussed. H=M, the arithmetic mean matrix gives the well known theorem of Mercer on limits (*Proc. Lond. Math. Soc.* (2), 5(1907), 206—24). Finally, the total relative strenght of two matrices U_α, U_β $(0 < \beta < \alpha)$ is compared, $U\beta$ being obtained similarly as

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SECTION OF STATISTICS

PRESIDENT: DR. U. S. NAIR, M.A., Ph.D., F.N.I.

Abstracts

Theoretical Statistics

1. On the Variance of Variance in the case of Finite Populations.

M. D. BHAT, Bombay.

A formula is developed and the magnitude of the variance is compared with that of infinite populations for various sample sizes.

2. Determination of the Confidence Belt of the Classical D^2-statistic.

P. K. BOSE, Calcutta.

It has been shown that the unbiassed and most powerful critical region based on the classical D^2-statistic is one tail end of the distribution. For (i) all alternatives $\lambda_2 > \lambda_1$ we have to consider the right-hand-side tail end and (ii) all alternatives $\lambda_2 < \lambda_1$ we have to consider the left-hand-side tail end.

Here starting with the unbiassed and most powderful critical region, 95% confidence belt for different values of L (for the two sets of alternatives) have been calculated.

3. Shape and Properties of Bessel Curves.

P. K. BOSE, Calcutta.

In this paper we have studied the shape of the Bessel Curve as we increase the values of the parameters.

Further, the possibility of using the Bessel Curve as a graduating curve for frequency data has been discussed.

4. On the Method of Group Averages in Estimation of Regression Coefficients.

V. J. CHACKO, Trivandrum.

The present paper is an extension of the method of group averages suggested by K. R. Nair in estimating regression coefficients from observational equations. The method of group averages consists in dividing the n residual equations into m sets of $p, q, r, \ldots$ equations in number, and by equating the sum of the residual equations in each set to zero, we get m equations to solve for the m parameters to be estimated. K. R. Nair in a paper "On a simple method of curve fitting" (published in *Sankhyā* Vol. VI) obtained the values of $p, q, r, \ldots$ by maximising the efficiency of the coefficient of the highest power in the regression equation. S. S. Bose has (*Sankhyā* Vol. III) indicated several methods of estimating the regression coefficients.

In this paper, the joint efficiency of the estimates of the parameters is maximised with respect to $p, q, r, \ldots$. The case of a linear regression is worked out in detail, and the working for higher degree polynomials, given in outline. The efficiencies of the estimates obtained by this method are compared with those obtained by the methods of K. R. Nair and S. S. Bose. The present method gives greater efficiency.

5. On the Ratio of the Mean Deviation to the Standard Deviation.

M. C. CHAKRABARTI, Bombay.

Let $n \geqslant 2$ and let $x_1, \ldots, x_n$ be n real numbers, not all equal. Let $\bar{x}$ denote the mean and λ denote the ratio of the mean deviation from the mean to the standard deviation. The object of the paper is to give several proofs of each of the results :

(i) $\lambda \leqslant 1$,

(ii) Max $\lambda(x_1, x_2, \ldots, x_n) = 1$ if n be even and $= (1 - 1/n^2)^{1/2}$ if n be odd and

(iii) Min $\lambda(x_1, x_2, \ldots, x_n) = (2/n)^{1/2}$. The second and the third results are belived to be new.

6. A Note on Sampling from Finite Populations.

K. C. CHERIYAN, Bombay.

An expression for the error involved when sampling is done from a stratified finite population and an estimate of the population variance calculated on the assumption that the population is infinite, is derived in this paper. The function of the sample values which correctly estimates the population variance is also derived.

7. Determination of the best Shape of a Sample-cut.

ANUKUL CHANDRA DAS, Calcutta.

If s and s' be two quads in the cut with co-ordinates (x, y) and (x', y') respectively, then the correlation between them is $\rho(x-x', y-y')$ or in polar co-ordinates $\rho(r, \theta)$ $0 \leqslant \theta \leqslant \pi$, $0 \leqslant r \leqslant r_0$ (say). Variance of total yield of the cut is proportional to $\int \rho(r, \theta) ds\, ds'$, where ds and ds' are elements of area and the integration is carried over the cut. To find the best shape of all possible shapes of same area α, the variance is to be minimised. Let w_0 be a region or cut such that (i) inside w_0 : $\rho(r, \theta) \leqslant \lambda$ and (ii) outside w_0 : $\rho(r, \theta) \geqslant \lambda$; λ being so chosen that $\int\int\int\int ds\, ds' = \alpha^2$, when integrated over the region. Then this w_0 is the best cut. There may be w_0 such that (i) inside w_0 : $\rho_1(r, \theta) \leqslant \lambda_1$ and (ii) outside w_0 : $\rho_1(r, \theta) \geqslant \lambda_1$, $(i = 1, 2, \ldots . m)$ subject to the condition that $\rho(r, \theta) = \phi\{\rho_1(r, \theta), \ldots \rho_m(r, \theta)\}$ and $\lambda = \phi(\lambda_1, \ldots \lambda_m)$, λ being defined above. Thus we get a group of best cuts of which the best one is to be selected.

A cut whose shape is independent of the parameters in $\rho(r, \theta)$ is the uniformly best cut, which will depend on the correlopiped.

8. Non-null Distribution of Canonical Correlations.

ANUKUL CHANDRA DAS, Calcutta.

The non-null distribution in case of two groups with characters p_1 and p_2 (being unequal) was found out. It came out as a function of (p, q)th moment of binomial populations having the sample and population canonical correlations as their parameters multiplied by the non-null distribution portion.

9. Two Dimensional Systematic, Stratified and Random Sampling.

ANUKL CHANDRA DAS, Calcutta.

Definition of a kind of two dimensional systematic sampling is given. The field was supposed to consist of n arrays of strata along x and m along y directions, in all mn strata. Each stratum contains k arrays of cells along x and l along y, in all kl cells. In stratified sampling ν cells are taken at random from each stratum, in all sample of size $mn\nu$. In systematic sampling, ν cells are taken at random from the first stratum. Then starting from any of these chosen cells every kth array along x and on it every lth cell is taken, getting a sample of same size $mn\nu$. A random sample of size $mn\nu$ also can be taken.

Let σ_r^2, σ_{st}^2 and σ_{sy}^2 be the variances of random, stratified and systematic samples respectively.

These variances were calculated and the following theorems were proved. Let $\rho(u, v)$ be the correlation between two points u, v apart and let it be positive.

Theorem 1. For all infinite populations in which :

$$\left.\begin{array}{ll}(i) & \delta_1^2\rho(u, v) \geqslant o \\ (ii) & \delta_2^2\rho(u, v) \geqslant o \\ (iii) & \delta_1^2\delta_2^2\rho(u, v) \geqslant o\end{array}\right\} \delta = E^{1/2} - E^{-1/2} \qquad \left.\begin{array}{l}\\ \\ \\ \end{array}\right\} Ef(u) = f(u+1)$$

$\sigma_{sy}^2 \leqslant \sigma_{st}^2$ for any size of sample ; and $\sigma_{sy}^2 < \sigma_{st}^2$ unless equality holds in each of the above three cases.

Theorem 2. For all populations in which :

$$\left.\begin{array}{ll}(i) & \Delta_1\Delta_2\rho(u, v) \geqslant 0 \\ (ii) & \Delta_1\rho(u, v) \leqslant 0 \\ (iii) & \Delta_2\rho(u, v) \leqslant 0\end{array}\right\} \Delta = (E-1)$$

$\sigma_{st}^2 \leqslant \sigma_r^2$.

Theorem 3. Under conditions of theorems (1) and (2), $\sigma_{sy}^2 \leqslant \sigma_{st}^2 \leqslant \sigma_r^2$.

10. On a particular type of Natural Field.

BIRENDRANATH GHOSH, Calcutta.

In a uni-dimensional field, under the condition (no. 1) that the partial spatial correlation between any two points A, C, for a given intermediate point B, is zero, the spatial correlation $r(u)$ for an interval of length u, takes the form $exp(-gu)$, using the positive numerical value of u, obviously (Bojarski, 1941). This form has been observed in some natural fields (Osborne 1942). Matern (1947) has generalised the form to $r = \Sigma p_i exp(-g_i u)$, $(\Sigma p_i = 1 ; p_i, g_i \geqslant 0)$, for which however the condition no. 1 breaks down.

In a two-dimensional field with directional heterogeneity, suppose the x and y axes are chosen along two principal orthogonal directions (*e.g.*, along and across the rows in a crop-field where the plants are sown in rows). In such a field, if, besides condition no. 1 holding along both the x and y directions separately, there is another condition (no. 2) that the partial correlation between the points D, F for a given point E is zero, when D, E, F are so arranged that $DE = u$ along x and $EF = v$ along y, then the spatial correlation $r(u, v)$ comes out in the form $exp(-gu-hv)$. This form can also be generalised to $\Sigma p_i exp(-g_i u)\Sigma q_j exp(-h_j v)$, i running from 1 to k, and j from 1 to k' ; $(\Sigma p_i = \Sigma q_j = 1 ; p_i, q_j, g_i, h_j \geqslant 0)$; for this form condition (2) holds, but condition (1) breaks down. The forms of r for the unidimensional fields can be derived from the corresponding forms for two-dimensioned fields, simply by putting $v=0$. The simpler forms for both unidimensional and two-dimensional fields can be derived from the generalised forms of r by putting p_i, q_j equal to 1 for $i=j=1$, and equal to zero for other values of i and j.

11. Variance and Covariance of Rectangular and "Linear" Sample-units for a type of Natural Field.

BIRENDRANATH GHOSH, Calcutta.

Let V(X, Y) be the variance of a rectangular sample-unit (s.u.) with sides X and Y along the x and y directions, for a density-like variate (like yield per acre, proporton of land under crop, population density, etc.). If the spatial correlation $r(u, v)$ be of the form $\Sigma p_i\, exp(-g_i u)\ \Sigma q_j exp(-h_j v)$, with u, v along the x and y directions respectively, and σ^2 represents the variance of the basic cells in the field, then $V(X, Y) = \sigma^2\, \Sigma p_i\, \phi(g_i, X) \times \Sigma q_j \phi(h_j, Y)$, where $\phi(a,b) = \frac{2}{ab}[1 + \frac{1}{ab}\{exp(-ab)-1\}] = 2\{1/2\,!-ab/3\,! + (ab)^2/4\,! - (ab)^3/5\,! + \ldots.\}$ For the similar case for unidimensional field, a "linear" s.u. of length X, $V(X) = \sigma^2\, \Sigma p_i\, \phi(g_i, X)$

In the two-dimensional fields, let us take two "linear" s.u.'s of lengths L, M (parallel to the x axis) whose nearest points are separated from each other by a distance c

in the x direction and d in the y direction. Then the covariance between these two s.u's will be given by

$$\sigma^2 \Sigma q_j \exp(-h_j d)\, \Sigma p_i\, \psi(L, M, C, g_i),$$

where
$$\psi(L, M, c, g) = \frac{1}{LMg^2} \exp(-gc)\{\exp(-gL)-1\}\{\exp(-gM)-1\},$$

$$= \exp(-gc)\{-1+gL/2!-(gL)^2/3!+\ldots\}\{-1+gM/2!-(gM)^2/3!+\ldots\}.$$

By putting $d=0$, we get the two " linear " s.u.'s lying on the same line ; $d=0$ also gives the case for unidimensional field.

12. Methods of deducing the Normal and the Poisson Distributions as Approximations to the Binomial.

M. V. JAMBUNATHAN, Calcutta..

It is usual to show that the Normal Distribution as well as the Poisson Exponential can be derived as approximation of the Point Binomial. Most of the text-books (*e.g.* Yule and Kendall's book) employ Stirling's approximation to $n!$, though it is possible to arrive at the same results by simpler algebraic methods without resort to Stirling's formula. It is claimed that this method is no less rigorous than any that is usually employed.

13. Estimation of Parameters from Incomplete Data with application to Design of Sample Surveys.

A. MATTHAI, Calcutta.

In this paper it has been shown that improved estimates can be obtained from incomplete data when the data relate to correlated variables. For a population characterised by two measurements a sample may consist of $N=n+n_1+n_2$ individuals, n_1 providing the first measurement alone, n_2 the second alone and n both. A parameter like the mean, say for the first measurement, can be estimated from the set of $n+n_1$ observations only. Assuming, however, normal distribution for the measurements, the maximum likelihood estimates obtained by taking the whole sample into consideration, have been shown, in case of correlated measurements, to be more accurate than those obtained from individual sets of sample values. Similar estimation in the case of more than two variables has been indicated with example.

The utility of this technique in designing sample surveys has also been brought out with the help of example. The optimum number of common sample-units to be retained in "second " and later surveys has also been derived.

14. A Note on a Distribution related to the Wishart Distribution.

K. NAGABHUSHANAM, Andhra.

In this note a straight and short proof, based on tensor ideas, is given for the functional form (F), given below, recently obtained by G. Rash, of the Distribution Function of the product moment matrix of Wishart's n-vector distribution in a space of k dimensions.

$$p(M)=C\,\phi^{\frac{n}{2}}\, e^{-\frac{1}{2}\sum_{ij}\phi_{ij}M_{ij}}\, M^{\frac{n-k-1}{2}}. \qquad \ldots\ldots\ldots\ldots(F)$$

15. Sequential Tests for Regression Problem.

H. K. NANDI, Calcutta.

It was observed in a previous communication that for testing the significance of simple and multiple regression co-efficients in a sample of fixed size the first kind of error can be controlled independently of the distribution of certain variables, and the second kind of error also remains the same in a wide class of distributions of these random variables. If sequential tests based on the ratio of conditional probabilities are used, both the first and second kind of error are controlled at given levels independently of

the distributions of certain random variables. Though two points on the OC curve are thus controlled, the other points are affected by the distribution of these variables. However, certain two sample tests can be formulated which will make the power function independent of the variables in question.

16. Precision of the Estimates of the Components of Variance.

P. B. PATNAIK, Madras.

The difference between the 'random' and 'systematic' set-ups in the analysis of variance is considered with regard to the parameters involved. It is, however, shown that situations exist where the variability of the means of a set of units, which form the whole finite population, has a practical significance. Then this component of variation assignable to a systematic factor has to be estimated from the analysis of variance table, as also that assignable to a random factor. Methods of measuring the reliability or precision of these estimates are examined in this paper. The distributions of these estimates in the forms of (i) $a\chi_1^2 - b\chi_2^2$ in the random case and (ii) $a\chi'^2_1 - b\chi_2^2$ in the systematic case are obtained. The method of confidence intervals for measuring the reliability of an estimate is then discussed. It is found that a systematic component of variance can be estimated with much higher precision than a random component.

17. On the Distribution of the Ratio of two Ranges in Samples from Normal Population.

K. C. S. PILLAI, Trivandrum.

If x_1 and x_n are the smallest and largest observations in a sample of size n from a normal population,

$$w = x_n - x_1$$

gives the range. The distribution of $F' = (w_1/w)$ where w_1 and w are the ranges in two samples is studied in this paper. It will be noted that F' may be taken as a test for equality of variances.

The 5% and 1% significance limits for F' are tabled for values of n_1 and n_2 (< 10).

18. The General Theory of Fractional Replication in Factorial Experiments.

C. RADHAKRISHNA RAO, Calcutta.

The general theory of symmetrical factorial designs has been considered in detail by Bose, Kishen and Fisher. All the designs constructed by them can be made to depend on the combinatorial arrangements known as *hypercubes of strength 'd'*. In the present paper it is shown that these arrangements can also be used in the design and analysis of Fractional Replications.

The practical problem is the construction of a design using only a subset of the treatment combinations so as to admit the measurability of main effects and first order interactions unaffected by the presence of interaction up to the order $(d-1)$. It is shown that a set of sufficient conditions for the existence of such a design is (i) the subset of treatment combinations used is a hypercube of strength $(d+1)$ and (ii) each block of the design is a hypercube of strength 2.

Inequalities have been derived connecting the maximum number of factors that can be used and the other parameters of the design. Some useful designs have been listed.

Applied Statistics

19. On Curve Fitting for Meteorological Data.

M. D. BHAT, Bombay.

The relation between rainfall and temperature, sunshine and temperature, and the adequacy of the representation of rainfall and sunshine by orthogonal polynomials have been examined.

20. A Note on Designing Family Budget Surveys.

S. BHATTACHERYYA, Calcutta.

The paper is based on the enquiry into the family budgets of the middle class of Calcutta in 1945. The object of the paper is to study the correlation between two families living in the same house with regard to one of the most important features determining the economic status of the families, *viz.* the total family expenditure per month, and to show that if the correlation is not significantly high a great economy can be effected by including into the sample for future study a larger number of families from a fewer number of houses.

21. A Note on the Study of the Variations of the number of tablets per pound of Quinine Ammonium Sulphate.

CHAMELI BOSE, Calcutta.

An experiment was conducted at the cinchona plantation, Mungpoo, during the year 1944-45, to study the variations of the production of tablets per pound of Quinine Ammonium Sulphate.

Shewhart's quality control technique was used in analysing the data and it was found that the production of tablets was not under control. Several suggestions were made regarding the future planning of this type of experiment.

22. On Sample Checking of Coded Census Slips.

H. K. CHATURVEDI, Calcutta.

The paper describes the method and efficacy of a system of sample-checking recently introduced in the Indian Statistical Institute in the case of transferring to Hollerith cards the 1941 census sample slips. The slips number about 60 lacs and on each slip 21 items of information are coded for the purpose of preparing census tables with the help of Hollerith machines. When the volume of work is huge, it considerably saves both time and money if checking of the coded slips is not done hundred per cent but is reduced to its minimum consistent with the standard of accuracy. The principle underlying the system is to check thoroughly the slips in which the number of mistakes is found to be higher than the number of mistakes which can be tolerated and to check only a portion of the slips in which the number of mistakes is found to be lower than the tolerance limit. The actual working process, to which a lot (about 200 slips approximately) of coded slips is subjected, covers many stages of checking, the first being the checking of 25 per cent of the slips. It has been found that the desired accuracy is ultimately reached by checking only about fifty to sixty per cent of the total volume of the slips depending on the nature of the information recorded.

23. Route Sampling for Estimation of Cropped Area.

D. M. GANGULI, Calcutta.

Samples of size 2.25 acres have been generally used by the Indian Statistical Institute for estimation of the areas under major crops in Bengal. In case of minor crops, however, it was felt that relatively larger numbers of bigger sized samples would be necessary which would mean higher and in certain cases almost prohibitive costs. A small scale experiment was conducted to test an alternative and prima facie much more economical technique which is supposed to be applicable to all crops major or minor. Encouraging results were obtained, but more experiments would be needed before one could make safe recommendations. The details of the technique are indicated below:

A line was drawn in the village map joining the approximate centres of two plots having the highest and lowest plot numbers. The investigator was to cover this line across the village by walking along boundaries (*ails*) of the plots keeping as near to the line as possible. While thus walking he was to always look to the right (or left) and count and record the number of steps he took while walking along a particular type

of land (land under wheat, land under pulses, fallow etc.) and then again along land of some other type and so on till the end. The total distance (counted in steps) thus covered was related to the sample (village) area, while the percentage of the number of steps taken along any particular crop to the total number of steps taken was related to the percentage of that crop in the whole village.

24. A Note on the Size of Marginal and Economic Holdings in Bengal.

A. GHOSH, Calcutta.

The object of this note is to lay down the concepts and a statistical method of determining precisely the 'marginal' or 'minimum' and 'economic' size of holding, in cases where the agricultural economy presents a state of transition from subsistence to fully competitive economy, from certain a priori considerations involving certain realistic assumptions about the institutional factors. These concepts are thus sought to be fixed 'empirically' and freed from all possible subjective bias. The method used has been to fit appropriate curve to the area 'owned' and 'cultivated' and to deduce from the nature of the curve the 'optimum' holding as also a minimum holding.

25. On Estimates of Population of the Dominions of India and Pakistan for the year 1951.

G. V. KRISHNASWAMY, Annamalai.

In this paper, the author discusses different methods of estimating population figures for Provinces of India and Pakistan and gives the estimates for the year 1951.

26. A Sample Survey for Estimating Requirements of Potato seeds in West Bengal.

N. T. MATHEW *and* D. M. GANGULY, Calcutta.

A large proportion of the potato seeds used for cultivation in West Bengal is imported from other provinces. For regulating this import and for ensuring proper distribution of potato seeds at the sowing season it is important to have reliable estimates of the total requirements of the different varieties of potato in the different districts. A sample survey for obtaining this information was conducted in the crop season of 1947-48 by the Indian Statistical Institute. This paper gives an account of the survey and the results obtained.

27. A Note on the Size and Shape of Cuts in Crop-Cutting Surveys.

N. GOPALAKRISHNAN NAIR, Trivandrum.

In crop-cutting experiments, the usual assumption is that the yield from a cut is a random variable. The yield from a cut depends upon the number of plants in the cut and also on the yield per plant. Assuming that the plants are situated at equal distances and that the yield per plant remains constant, the yield from a cut varies because of the variation in the number of plants within the cut. This variation is studied in this paper.

The number of plants in a cut varies due to (1) shape and (2) random location of the cut. It has been shown that the circular cuts show minimum fluctuation in the number of plants due to random location. The expectation of the number of plants is equal to the area if the distance between plants is the unit of measurement whatever be the shape of the cut.

28. Technique in the Analysis of Financial Statements of Joint Stock Companies.

V. G. PENDHARKAR, Bombay.

The financial statements and balance sheets issued annually by the joint stock companies under the Indian Companies Act contain a wealth of data of considerable interest to the economic statistician. Properly analysed they would yield valuable information on a number of aspects of the capital market. However, there are two main difficulties in the way of the statistician. In the first place, the data are too numerous and secondly, owing to different accounting practices the meaning and composition of different items differ from one balance sheet to another. The first difficulty can be solved by sampling, subject, of course, to the second consideration.

Since the main interest in such analysis is the estimation of various totals such as total depreciation allowances or total funds raised from short-term borrowing etc. a stratified sample with a suitable cut-off line appears to be most useful. The choice of an appropriate variable is most important here. In the paper presented the actual technique used and the results obtained in the case of a fairly homogeneous and small population are discussed.

29. A Sampling Investigation into Physical Measurements and Tests of Efficiency.

D. V. RAJALAKSHMAN, Madras.

In order to fully achieve the aims and objectives of physical education in schools, it is essential to evolve a scientific procedure for studyig the physical attainments of school children. Since the performance of boys in efficiency tests framed to study their physical attainments depends on their age and physical measurements besides individual ability, a proper approach is to classify them into homogeneous groups based on a reliable index and set separate standards of performance for tests to each group. Although, at present, some empirical formulae are in vogue, reliable basis of classification suitable for Indian conditions is not available. As a preliminary step to attain this objective a sampling investigation has been conducted into the physical measurements and efficiency in performances of 1,481 school boys in Madras.

This paper embodies the results of this sampling enquiry. The collected data have been utilised to study the relationship between age and different physical measurements like height and weight, and their bearing on the performances. Attempts have also been made to provide the basis for the classification of children into homogeneous groups for fixing standards of performance to each group in tests of efficiency.

30. Indian Economy under Inflation.

T. GHOSH, Calcutta.

In this paper the general principles of Indian Economy under inflation has been discussed. Author has further discussed the Government of India's anti-inflationary plan.

36th INDIAN SCIENCE CONGRESS, ALLAHABAD, 1949.

SECTION OF PHYSICS

PRESIDENT : DR. R. S. KRISHNAN, M.A., D.Sc., Ph.D. (Cantab).

Abstracts

1. On Sound Absorption in Liquids.

R. N. GHOSH *and* GURUDEV SHARAN VERMA, Allahabad.

This is a preliminary report about the measurements of absorption of sound in liquids in the ultrasonic region with an ultrasonic interferometer. This is based upon noting the reaction of the reflected waves on the vibrating crystal as the reflector is approached to or withdrawn away from the source.

Preliminary measurements were first of all taken in air to test the apparatus. The results have been found to be in excellent agreement with the expected theoretical values.

Measurements in the case of Benzene yield for the 'frequency free' coefficient of absorption $\alpha/N^2 \times 10^{17} = 940$ approx.—a value which is about 100 times the value which is explained by viscosity and heat conduction.

Investigations in the case of transformer oil give $\alpha = .00208$ cm^{-1}.—a value which can be explained by viscosity alone.

With acetic acid the work is being continued at the time of writing; it is hoped to work with different frequencies.

2. Dispersion and Absorption of Sound in Gases.

S. K. K. JATKAR *and* D. LAXMINARAYANAN, Bangalore.

A theory to account for the observed dispersion and absorption of sound at low frequencies has been advanced. It is found that molecules with anisotropic Van der Wall's fields can oscillate in the field of one another and the frequency of vibration is given by $\nu = \frac{1}{2\pi}\sqrt{\frac{E}{I}}$ where E is of the order of Van der Wall's energy of attraction and I the moment of inertia of the molecule. It is found that this oscillation can account for the dispersion of sound and absorption of sound at low frequencies. The frequency region calculated from the above equation agrees with that found by experiment in order of magnitude in all the cases. The quantities E have been calculated from London's equation for Van der Wall's interaction in terms of optical frequencies. This gives the link between the acoustical dispersion and optical frequencies even though they by themselves differ by several orders of magnitude. Calculations using Slater and Kirkwood's formula for Van der wall's forces also give results in agreement with the acoustical frequency of dispersion.

3. Effect of Increasing Length of the Sound Wave on Ultrasonic Diffraction at 35 Mcs.

B. RAMACHANDRA RAO, Waltair.

Progressive sound waves of frequency 35 Mcs/sec are set up in a long column of water using a 2" length quartz crystal with a fundamental frequency of 1.2 Mcs/sec, excited by an oscillator employing Taylor T-55 valve. The usual Debye-Sears arrangement is used for obtaining the first order diffraction lines for normal incidence and their

intensities estimated visually for different lengths of sound field, the length of the sound beam being varied by an air-film enclosed between two glass plates whose position is noted by an index moving on a millimetre scale. The intensities of both the first order diffraction lines exhibited a periodic fluctuation, the distance between successive minima being 9mm in agreement with the theoretical value of 8.4 mm obtained from expressions given by Nath, Rytov and David. The experimental results do not fit into the theory in the respect that the intensity of the first orders do not go through minima of zero. This was explained as due to the progressive damping of the sound wave due to the high absorption by the liquid at these frequencies.

4. Apparent Non-Ohmic Nature of Electrical Conduction in Single Crystals of Molybdenite.

AJIT KUMAR DUTTA, Calcutta.

For currents both along and at right angles to the basal plane of molybdenite single crystals, the current-voltage relation has been found to be non-Ohmic. This non-Ohmic nature of current-voltage relation vanishes when the crystal is heated to about 150° C. This has been explained to be nothing but an effect of rectifying action of the crystal which vanishes with the rise of temperature. This explanation is further shown to be qualitatively supported by the findings of all theoretical investigators on rectification.

5. Dielectric Dispersion of Water.

S. K. K. JATKAR *and* B. R. Y. IYENGAR, Bangalore.

The data of recent measurements on the dielectric constants and loss angle of water at different temperatures and frequencies has been used to calculate the critical frequency and molecular radius of water, by applying the new equation for dielectric dispersion of polar liquids. A temperature independent value of 1.4 Å is obtained for the molecular radius in agreement with the accepted value.

6. Dielectric Dispersion of Polar Solutions.

S. K. K. JATKAR *and* B. R. Y. IYENGAR, Bangalore.

An expression has been derived for the dielectric dispersion of polar solutions taking into consideration the individual orientations and relaxation times of the molecules of the polar components. Oncley's semi-empirical relationship which has been applied to solution of proteins is shown to follow from the new equation, after effecting certain valid approximations. It has also been pointed out that the equation used by Collie, Hasted and Ritson to interpret the dispersion of aqueous ionic solutions is erroneous.

7. Kerr Constant of Liquids.

S. K. K. JATKAR *and* B. R. Y. IYEGNAR, Bangalore.

The Kerr Constants of nonpolar liquids have been interpreted on the basis of the new relationship

$$B = \frac{3\pi N}{\lambda}\left[\frac{1}{15KT}\{(\alpha_1-\alpha_2)^2+(\alpha_2-\alpha_3)^2+(\alpha_3-\alpha_1)^2\} + \frac{1}{15K^2T^2}\{(\mu_1^2-\mu_2^2)(\alpha_1-\alpha_2) + (\mu_2^2-\mu_3^2)(\alpha_2-\alpha_3)+(\mu_3^2-\mu_1^2)(\alpha_3-\alpha_1)\}\right]$$

which has been derived using the new law of polarisation $(\varepsilon-1; n^2-1)$ in place of the Clausius-Mosotti law $\left(\frac{\varepsilon-1}{\varepsilon+2}; \frac{n^2-1}{n^2+2}\right)$ and taking into account the restricted freedom of orientation of molecules in liquids. The Kerr constants of benzene, carbondisulphide, toluene, ortho, meta and para xylenes, napthalene (nonpolar); chlorobenzene,

chloroform, nitrobenzene, ether and acetone (polar) calculated by the new equation using the polarizability values and other anisotropy constants obtained from vapour data show agreement with the observed values. The values calculated by Langevin-Born formula show wide deviation from the observed value. The new equation also satisfactorily explains the temperature coefficient of the Kerr Constants of liquids.

8. Dielectric Constants of Tourmalines.

D. A. A. S. NARAYANA RAO, Waltair.

The dielectric constants of yellow tourmaline, rose-red tourmaline, dark-green tourmaline, and a number of black opaque tourmalines are determined by a liquid mixture method at a frequency of 1.6 Mcs and a temparature of 28°C. The values obtained for different coloured specimens are different. In the case of the black specimens, which are of the iron type, there is a regular variation of the dielectric constant in any direction with density.

9. Faraday Effect in Crystals and Solution : Potassium Alum.

S. RAMASESHAN, Bangalore.

The Faraday effect and the Magneto-optic anomaly in single crystals and solutions of potassium alum have been measured for the wave lengths λ 5893 and λ 5461 and it is found that while the value of magneto-optic anomaly of the crystal is 53.3%, that for the different solutions is of the order of 75%. The anomaly decreases with decreasing concentration.

10. Nuclear Magnetic Resonance and the Effect of the Methods of Observation.

G. SURYAN, Bangalore.

In this paper factors affecting the time required for nuclei precessing in a magnetic field to lose their energies to the surrounding medium have been investigated and calculations performed. It has been observed that the present methods of observing either nuclear magnetic absorption or nuclear induction involving the placing of the sample in a resonant circuit gives rise to losses from the nuclei in times of the order of a second. Calculations for the same have been performed both on the picture of circuit theory and on the picture of precessing nuclei. That the presence of the circuit can affect the observed nuclear relaxation times to a considerable extent is apparent. This is of utmost importance in finding the true relaxation times due to either spin-spin or spin-lattice interaction. Results indicate that the effect of the resonant circuit depends on the Q of the circuit. It is therefore possible to test these results by means of experiment. It is also found that the presence of some loosely bound electrons in ionic crystals is likely to have a large effect in the observed short relaxation times. These may to some extent clarify the unexpectedly short relaxation times found in certain crystals like LiF even at very low temperatures.

11. A new method of observing Nuclear Paramagnetic Absorption.

G. SURYAN, Bangalore.

A new method of using the autodyne detector for nuclear paramagnetic absorption has been developed. The requirements for a sensitive detector are (1) the power level should be low, (2) high R.F. amplification must be possible. In the ordinary autodyne detector these requirements are not fully satisfied because of high instability when low power levels are approached. In the present method low power levels have been obtained by the use of harmonics of an oscillator which is just oscillating. This leads to elimination of most of the disadvantages of the autodyne detector and the sensitivity is quite high. A reciever followed by a cathode-ray tube indicator was used

as usual to facilitate observation. With this apparatus a week resonance due to metallic copper (spin 3/2) has been observed. Also it was found that a very weak but observable absorption corresponding to an absorption of quanta of energy $h(2\nu)$ at a given value of magnetic field takes place. Whether this is due to the taking place of forbidden transitions or due to the method of observation has to be determined by further experiment. Limitations in the way of using this method are the requirements of very steady and very uniform magnetic fields; otherwise very unsteady oscilloscope patterns result.

12. The Oscillatory Motion of the Space Charge Sheath in Phase with the Exciting Voltage: A probable cause of the *Joshi-Effect*.

H. J. ARNIKAR, Banaras.

Photoelectric emission from the boundary layer formed by adsorption of ions and excited molecules produced under the discharge is postulated by Joshi as the primary factor of the above-effect, (S. S. Joshi, *Curr. Sci.*, 1945, *14*, 175; and *ibid*, 1947, *16*, 19). In the present theory it is assumed: (i) that a negative ionic sheath is formed as a consequence of this emission, and (ii) that this sheath can oscillate coaxially between the electrodes in phase with the voltage of the H.T. electrode, as the latter acts alternately as a pro- and anti-biassed grid to the sheath. Two such sheaths can be formed, one from each electrode boundary layer. Of these, the one emanating from the L.T. (outer) electrode is regarded, under conditions of maximum *Joshi-effect*, as relatively stable and coextant with irradiation, in consequence of a presumable dynamic equilibrium between the ion-removing and adding processes from and to the sheath. In the case of the similar boundary layer on the surface of the H.T. (inner) electrode, however, photoemission being not possible during at least the positive half of the cycle, the corresponding space charge sheath can only be intermittently formed, whose general effect will be to make the oscillations of the stable sheath (the first one) asymmetric in the two consecutive half cycles. Further, the synchronous movements of the charge sheaths in phase with the voltage may be expected to include besides the A.C. input frequency and its harmonics, (certain) high frequencies possibly extending up to the R.F. range. The interference of these latter with the H.F. components shown earlier by Joshi (*Nature*, 1944, *154*, 147) to be present in the discharge current must be regarded more or less complete to account for the large suppression of the current caused by irradiation. Similar suppression of the current due to the heterodyning of frequencies of different ranges has been previously reported, (G. S. Tiwari, *Proc. Ind. Sci. Cong.*, 1946, *Phys. Sec.*, Abst. No. 31).

The observed decrease in the magnitude of the *Joshi-effect* ($\%\Delta i$) with the increase of gas pressure and temperature, as well as with the input frequency of the exciting field, and the voltage above the optimum value, are shown to be necessary corollaries of such a hypothesis. Further, while the formation of the sheath immediately follow the capture of the emitted photoelectrons by the gas molecules (and/or atoms) of the excited gas, its removal is a relatively slower process, as the destruction of the sheath has to be effected by the continued kinetic-molecular, and ionic agitations against it. This anticipation from the present theory is borne out in practice by the finding that the ratio of the times for current recovery in dark and its suppression under light is slightly, but distinctly, greater than unity, especially under conditions of maximum *Joshi-effect*.

13. The *Joshi-Effect* in Air.

H. J. ARNIKAR, Banaras.

By using a specially large size Siemens' glass ozoniser with a total electrode surface of about 12,000 sq. cm., it has been possible to obtain in dry and CO_2-free air as large as 95% negative *Joshi-effect*, in marked contrast to the low values (about 3% or less) reported by the earlier workers, (G. S. Deshmukh, *Journ. Ind. Chem. Soc.*, 1947, *24*, 211; and K. V. Rao, *Proc. Ind. Acad. Sci.*, 1948, *27*, 72). At given irradiation and voltage, increase of gas pressure and frequency of the A. C. supply generally lowered the $\%$-*Joshi-effect*. Thus, raising the pressure from 2.5 to 100 mm Hg lowered the relative *Joshi-effect* from 95 to 30% (50 cycles frequency), and changing the frequency from 50 to 500 cycles per second reduced the *Joshi-effect* from 95 to 62% (2.5 mm. Hg pressure). Under constant gas pressure and A. C. frequency, the *Joshi-effect* rises to a maximum just above the threshold potential, V_m, and for further increase of

voltage, the *Joshi-effect* diminishes rapidly at first and then more slowly. Thus, at a pressure of 2.5 mm Hg, and A.C. frequency of 50 cycles, the *Joshi-effect* rises from 75% at the threshold potential of 0.23 *k*V, to 95% at 0.30*k*V. It then falls to 15% at 0.60 *k*V and finally trails off to about 1% at 3.0 *k*V.

In the case of A.C. frequency of 500 cycles, the negative *Joshi-effect* changed over to a small positive effect at a certain voltage, the negative and positive effects being sharply potential reversible. This critical voltage rose from 0.88 to 2.09 *k*V for raising the pressure from 2.5 to 48.5 mm Hg.

In marked contrast with the halogens and mercury vapour, air showed a diminishing *Joshi-effect* with prolonged ageing under excitation. Concomitant with this was noted a partial disappearance of the gas. The adsorption involved in this clean up, if regarded as constituting a secondary layer over the initially formed photoactive layer of Joshi's postulate (*Curr. Sci.*, 1945, *14*, 175), a simple explanation of the detrimental influence of ageing becomes possible.

14. Production of the *Joshi-Effect* in Selenium.

H. J. ARNIKAR, Banaras.

The above phenomenon has been observed, for the first time in this field of work, in selenium-selenium vapour interface. A Siemens' ozoniser fitted with a side tube containing a sample of purified selenium (red amorphous) was energised by fields due to 50, 100, and 500 cycles per second. An appreciable negative *Joshi-effect* ($-\Delta i$) was observed in all the cases, sensibly above the threshold potential, where it is a maximum, as also its relative value, (*viz.*, $\%\Delta i = 100\, i/i_0$, where i_0 is the current in the dark at a given applied voltage V). $-\Delta i$ decreased but little, by increasing V from 1.63 to 6.25 *k*V (50 cycles); the relative effect, $\%\Delta i$, however, decreased rapidly from 50 to 22% for the same voltage range. The influence of increasing the supply frequency was to diminish $\%\Delta i$ *e.g.*, from 67 to 50% for a frequency change from 50 to 500 cycles per second.

Duration of ageing the system under the discharge had a marked effect on the magnitude of the phenomenon : Whilst $-\Delta i$ set in with but negligible ageing required for its production, its prolonged continuation even at the optimum exciting potential had a suppressant effect. It was remarkable, however, to observe that by nearly allowing the system to rest, the effect was restored, the more completely the longer the rest period.

The production of the negative *Joshi-effect* in selenium is significant in view of its well known photoconductivity.

15. The *Joshi-Effect* and the Phenomenon of Corona Pressure in Air.

H. J. ARNIKAR, Banaras.

The corona pressure, *viz.*, an instantaneous and reversible pressure rise occurring with the application of the field was shown by Joshi to be as high as a few cm Hg in the case of an ozoniser discharge. (*Malaviya Commemoration Volume*, 1932, *pp.* 807-821). The observation by the writer (*Proc. Ind. Sci. Cong.*, 1941, *Phys. Sec.*, Abst. No. 9) (i) of *synchronism between the gas pressure and temperature* throughout the period of several hours of discharge at constant voltage and under steady rate of electrode cooling (effected by circulating ice-cooled water around both the L.T. and H.T. electrodes) and, (ii) of a *complete coincidence in the observed and calculated equilibrium pressures*, indicate that the entire pressure rise is compatible with the temperature rise of the gas under discharge. The extreme rapidity of its occurrence, which distinguishes the corona pressure phenomenon from the pressure rise occurring when the same wattage is dissipated in the gas by, say, a heating coil, is attributed by Tyndall (*Phil. Mag.*, 1918, *35*, 261) to the rapid distribution of the heat produced throughout the gas by the *ionic wind* arising from the oriented motion of the fast ions between the electrode surfaces. This view is consistent with our finding that the corona pressure occurs only at voltages well above V_m, the minimum required to initiate ionisation by collision.

That part of the pressure rise due to ionisation, which Tyndall (*loc. cit.*) had shown cannot exceed 0.5% of the total pressure rise, is given by $p = i/4\pi k$, where p is the pressure rise, i the current per cm. length of the electrode, and k the specific ionic velocity. This component of the pressure rise being a function of discharge current, can be

expected to be sensitive to irradiation by light, as i is affected by the *Joshi-effect* during such irradiation. A careful search for a change in the corona pressure in air, employing a reading microscope with an eye-piece scale reading 1/15 mm, did not reveal any such change, as the conditions in respect of gas pressure, voltage, and A.C. frequency of the exciting field, for the occurrence of the *Joshi-Effect* and corona pressure were different. This indicated anti-correspondence between the two phenomena. Thus, in air, measurable corona pressure of the order of 0.1 mm Hg set in only at a minimum pressure of about 12 mm Hg, and at an exciting potential of 3.0 *k*V (500 cycles), or 7.5 *k*V (50 cycles); whereas the *Joshi-effect* had diminished to a negligibly small value at a lower pressure and much feebler exciting field. In other gases, however, it may be possible to locate a common range of conditions where both the effects are measurable.

16. On the Disparity in the Times for Current Suppression and Restoration in the Production of *Joshi-Effect*.

H. J. Arnikar *and* S. R. Visvanathan, Banaras.

Professor Joshi had observed (*Curr. Sci.*, Oct. 1944, *13*, 253-54) using a cathode ray oscillograph that the time lag in the production of the above phenomenon $-\Delta i$, in Siemens' or wire-in-cylinder type ozonisers, lies within limits of visual persistence. During subsequent work (unpublished results) Prof. Joshi observed that the time for the restoration of i_L, the current under irradiation to i_D, the original value in dark, was sensibly greater than that for the photo-suppression of current, $-\Delta i$. It was of interest to investigate the generality of the above finding. The results now reported refer to the ratio T_r/T_s, time T_r for the restoration (when light is screened off) of the photocurrent i_L to that in dark i_D and T_s, the time for the suppression of i_D to i_L. This quantity has been measured in the production of the *Joshi-effect* $-\Delta i$, in chlorine, bromine and mercury vapour, when excited by potentials varied in the range 1-6 kilo volts (r.m.s.) of 50 and 500 cycles supply frequency, at room temperatures and with bromine from 29° to 50°C. A remarkable parallelism has been observed between the values for the ratio T_r/T_s with the corresponding magnitude of the *Joshi-effect*. All the factors *e.g.*, large rise in exciting potential, of the supply frequency and of the temperature of the system, which (numerically) reduce $-\%\Delta i$, bring the above ratio near equality. The results are in general accord with Prof. Joshi's theory of the phenomenon based on the photo-electric emission from a boundary layer formed in part by an adsorption of ions and excited molecules produced under the discharge. (*Curr. Sci.*, 1947, *16*, 19-21; and, *Proc. Indian Sci. Cong.*, 1946, *Phys. Sec.*, Abst. 25)

17. On the Production of *Joshi-Effect* in Sulphur Vapour.

P. Das Gupta, Banaras.

Joshi effect in *pure* sulphur vapour was observed almost immediately without any long period of '*ageing*' under the discharge being necessary. At the 'threshold potential' the relative *Joshi effect* ($\%\Delta i$) was about 60% which declined steeply on increase of V, the applied potential. The $\%\Delta i$ decreased in the following order: blue, green, red. Under X-rays $\%\Delta i$ obtained was 10; under ultra violet it was about 80. In the range 30° to 55°C $\%\Delta i$ increased from 60 to 70 and diminished thereafter to about 40 at 70°C. The discharge current in dark (i_D) and in light (i_L), however, increased steadily with temperature.

It was observed that mercury vapour exerted a markedly inhibitive influence on the production of the *Joshi effect* in sulphur, presumably due to the formation, under the discharge, of HgS. A much longer period of 'ageing' under the discharge (about 6 hours) was necessary to obtain Joshi effect in sulphur vapour in the presence of mercury vapour.

18. Inhibitive Influence of Serial Resistance on *Joshi-Effect* in Sulphur.

P. Das Gupta, Banaras.

The effect of resistive coupling on the production of *Joshi-Effect* is inhibitive. This is due to the increase of 'damping constant' in the oscillatory circuit. It is in agreement with Joshi's results that H.F. constitute the chief seat of the phenomenon.

Influence of resistive coupling on *Joshi-Effect* in sulphur vapour was investigated. Phenomenon was observed only at R=100 Ω or less. The maximum relative *Joshi-Effect* ($\%\Delta i$) obtained with R=100 Ω was about 15%. Result at greater R showed larger i but no effect was observed. In agreement with previous result of Joshi the $\%\Delta i$ in i_{serial} in sulphur vapour was found to be markedly greater than in the total current $i_{L.T.}$ The 'threshold potential' V_m was found to be indepedent of frequency regions; $\%\Delta i$ at V_m was maximum in both cases. On increase of V $\%\Delta i$ decreased, *e.g.*, at $V_m = 0.7kV\ \%\Delta i$ in i_{serial} and $i_{L.T.}$ were 62 and 51; at $V = 0.8kV\ \%\Delta i$ were 24 and 11 respectively. This is attributed to the corresponding preponderence of $i_{L.T.}$ which is least affected in the production of the phenomenon.

19. Comparative Study of Hysteresis and the *Joshi-Effect* in Discharge in Chlorine, Bromine, Iodine and Oxygen.

G. S. Deshmukh *and* P. K. Sharma, Banaras.

Results are given for the variation of the conductivity i and the *Joshi-Effect* Δi with the rising and falling applied potential V in homogeneous discharge in Cl_2, Br_2, I_2 and O_2. Four Siemens' typo (glass) ozonisers A, B, C and D filled with purified chlorine bromine, iodine and oxygen respectively were excited at the 'threshold potential' V_m of50 and 500 cycles frequency. The exciting potential was then increased progressively to a maximum and reduced to the initial minimum. The current indicator was a reflection galvanometer actuated by a 83 V double diode. During the reversal of V, i and Δi were found to be greater for the decreasing field than that observed during its progressive increase. Hysteresis was more pronounced in i_D than in i_L and was maximum near V_M. As judged by the variation of i and Δi at V_m, the magnitude of hysteresis decrease in the order $Cl_2 > Br_2 > I_2 > O_2$. Whilst Δi was larger at 50 than at 500 cycles frequency, hysteresis varied in the opposite manner. In excited oxygen, hysteresis was comparatively more pronounced in a semi-oxoniser than that observed in a full ozoniser and especially when instead of platinum a silver wire was used as the central H.T. electrode. The reversal of polarity increased i and Δi; hysteresis was, however, not affected sensibly. Whereas, 'ageing' increased the magnitude of Δi, that of hysteresis was affected adversely. In excited iodine hysteresis was abolished with but a negligible 'ageing' of the system.

20. Influence of Earthing an Axial Metal Wire in the Discharge Space on *Joshi-Effect* in Chlorine,

D. P. Jatar, Saugor.

The influence of earthing a metallic wire along the axis of a discharge tube excited by side sleeves was studied on *Joshi-Effect* in Chlorine. It is found that on earthing the axial wire the discharge current i and the *net Joshi-effect*, Δi, measured in the L.T. line, fall appreciably. The relative *Joshi-effect* $\%\Delta i$, however increases near the threshold potential V_m, and is less for higher voltages on earthing the axial wire directly. When it is earthed through an ohmic resistance, i further falls to a very slight extent as also $\%\Delta i$. The magnitude of $\%\Delta i$ in case of earthing through a resistance is higher than that when it is left floating. Introduction of a bypass condenser in parallel with the resistance is found to restore, nearly completely, the suppression due to the ohmic resistance.

An attempt has been made to explain these results on the "activated layer postulate" and the preferential damping of the high frequency components of the discharge current by ohmic resistance as suggested by Prof. Joshi.

21. Influence of a Serial Resistance and a Bypass Condenser in the Low Tension Line on *Joshi-Effect* in Chlorine.

D. P. Jatar, Saugor.

Earlier results (Joshi–*Pro. Ind. Acad. Sci.*, Vol. XXII, 1945,225) show a suppression of the discharge current i, the net *Joshi-effect*, Δi, and the *relative Joshi-effect*, $\%\Delta i$, by a high resistive impedance introduced in the circuit. The results now obtained

show that the above reduction is restored on introducing a condenser bypassing the resistive impedance. A discharge tube filled with chlorine was excited by side sleeves. An ohmic resistance from 0.25 M to 1.0 M was introduced between the L.T. sleeve and the earth. In accordance with earlier results (*ibid*) i, Δi, & % Δi were found to decrease appreciably, the reduction being greater for higher resistance, more pronounced near the threshold potential, V_m. This effect was restored, practically completely, by introducing in parallel with the ohmic resistance a bypass condenser ranging from 0.02 μf to 0.0002 μf; the restoration being more complete near V_m. The above results have been interpreted on the preferential damping of the high frequency components of the discharge current as suggested by Joshi.

22. Production of *Positive Joshi-Effect* in Chlorine under Electrical discharge.

B. B. PRASAD, Banaras.

It has been shown by the author that the above phenomenon *viz.*, $+\Delta i$, a photo-increase of the conductivity, i under discharge, is associated with the L.F. component of i (communicated). The present work was undertaken to study the effect Δi in various other frequencies. A chlorine ozoniser was excited in the range 4-10kV; the discharge current was measured in a triode coupled resistively with the L.T.line. The whole of the apparatus was shielded by means of an earthed metallic enclosure. It was found that the $+\Delta i$ was as high as 400 percent. By eliminating successively higher frequency currents (which is a source of $-\Delta i$), *positive effect* $+\Delta i$ was found to increase. In the D. C. component, which arises out of the asymmetry of the system, only $-\Delta i$ of 26% was found. The very high frequencies showed, however, an enhanced $+\Delta i$. That the positive as well as negative *Joshi-effect* occur together and that an equilibrium exists between the two (*i.e.*, $+\Delta i = -\Delta i$) have been concluded.

23. Influence of Space Charge in the Detection of *Joshi-Effect.*

B. B. PRASAD *and* D. P. JATAR, Banaras.

That the above phenomenon *viz.*, Δi originates chiefly from the H.F. component of the discharge current i and that it is due to the formation of negative ions has been shown by Joshi (*Proc. Ind. Sci. Cong.*, 1946, *Phys. Sec.* Abst, 26; *Curr. Sci.*, 1945 *14*,67). The present work is intended to study the variation due to (electronic) space charge, and the modulation of the frequency thereby in the detector circuit, of the effect Δi. The discharge current (total L.T.) was allowed to flow through a Bell transformer, the latter being coupled to a diode T30 (RCA). The space charge in the detector was controlled by adjusting the filament temperature. At a given applied potential, kV an increase in the space charge initially decreases the effect Δi upto a certain limit after which it increases. Observations of Δi with other diodes, 6H6 and 80 on the other hand show always an increase of *Joshi-effect* $\%\Delta i$ tending to saturation. This last is more pronounced at higher kV besides the current i decreasing near saturation. Thus for *e.g.*, in 80 (RCA) and at 5.34 kV applied potential i decreases from 4.5 to 1.2 when the corresponding Δi increases from 66.6 to 66.8 only. Based on the variation of inter-electrode capacity due to change in space charge an explanation for the above results has been developed.

24. Influence of 'Ageing' on *Joshi-Effect* in Bromine Vapour under Electrical Discharge.

B. B. PRASAD *and* D. P. JATAR, Banaras.

The formation of an 'electrode layer' on the annular walls of a Siemens' ozoniser conveniently adopted for discharge reactions has been postulated by Joshi to be a primary condition for the production of the above phenomenon *viz.*, Δi (Joshi, *Proc. Ind. Sci. Cong.*, 1946.*Phys. Sec.* Abst. 26). The present work is an attempt at the elucidation of the extent of its variability in a Bromine filled glass ozoniser. A freshly prepared tube was exposed to electrical discharge due to 50 cycle A.C. till a stationary state characterised by constant conductivity and Δi was reached. This systen showed a

markedly low Δi when it was re-excited after two years of rest. Now restoration of Δi to its previous value took about 400 hours of long 'ageing'. It has been observed further that intermittent 'ageing' at low potentials (above the threshold V_m) is more effective in bringing the final state. The whole 'ageing' is found to be completed in several consecutive stages. A reversible reaction occurring between the glass and the gas has been concluded which is further supported by an increase in Δi due to a moderate rise in temperature. A possible means for studying reactions of this type merely by measuring the effect Δi has been suggested.

25. Production of a Potential-reversible *Positive-Negative Joshi-Effect* in Cl_2 under Semi-ozoniser Excitation.

B. B. Prasad *and* S. Swaminathan, Banaras.

Investigations using a semi-ozoniser with Ag-electrode coated with AgCl were carried out at potentials varying from 1-6*k*V of 50 cycle frequency. Only *Negative Joshi-Effect* $-\Delta i$ (*i.e.*, photo-diminution of current) of 93.5% occurs at the lower potential and almost exclusively *Positive-Effect* $+\Delta i$(*i.e.*, current increased by light) to an extent of 60% occurs at the higher potential.

At 1.34 *k*V the magnitude of *Negative-Joshi-Effect* $-\Delta i$ decreased progressively from 93.5% to 75.3% with decreasing intensity of white light. The dependence of *Joshi-Effect* on frequency was investigated by carrying out experiments with unfiltered white (7800-3700 Å) and filtered blue (4900-4200 Å), green (5300-4900 Å) and red (5900-5300Å) light. The magnitude of $-\Delta i$ varied frequency wise *i.e.*, white (93.5%) > blue (88.3%) green (64.9%) > red (50%) these values being obtained at the maximum intensity. Invariably a Fatigue-value (*i.e.* $-\Delta i$ was insensitive to variations in light intensities) was observed at low intensities.

At 5.34 *k*V the *positive-effect* increased with decrease of intensity, rises to a maximum and decreases slightly in white and increasingly rapidly in blue, green, and red. The *positive-effect* was found to vary between 17.5 and 29.7, 23.6 and 10.5, 26.2 and 6.1, and 30.6 and0.5 respectively with white, blue, green and red with intermediate maximum values of 36.7, 33.2, 32.7, and 32.3 respectively. In L.T. and L.F. the *positive effect* at the lowest intensity in the three spectral regions continues to be positive while in H.F. reversal to the *negative Joshi-Effect* occurs in blue, green and red at low intensities.

26. Studies on *Joshi-Effect* in Bromine : Influence of Light Intensity and Frequency in H.F. and L.F. Components of the Discharge Current.

B. B. Prasad *and* M. C. Jain, Banaras.

That the above phenomenon, *viz.*, Δi, originates primarily in H.F. part of the discharge current, $i_{H.F.}$ and that it is markedly susceptible to factors like intensity and frequency of irradiation, have been shown by Joshi. The present work was intended to study the influence of these factors on Δi, in $i_{H.F.}$ and $i_{L.F.}$ The total low tension current, $i_{L.T.}$, (or its H.F., L.F. parts separated by appropriate inducto-capacitative filters) was allowed to flow through a Bell transformer, the latter being coupled to the detector double diode 6H6 (RCA). Intensity of light was varied by changing the distance of the source from the ozoniser and lights of different frequency bands were obtained by using coloured glass strips; the latters' relative intensities were measured by means of a photo-meter.

The relation suggested by Joshi and Laxminarayaniah, *i.e.*, $\% \Delta i = aI^b$ for $i_{L.T.}$ was found to be applicable to $i_{H.F.}$ and $i_{L.F}$ also and with all the frequency filters, but only at low intensities. At higher intensities, however, this initial proportionality between log $\%\Delta i$ and log I as also between $\% \Delta i$ and I breaks down, and log $\%\Delta i$ or $\%i$, as the case may be, tends to saturation; for the latter an explanation based on the formation of a charged surface layer on the walls of the ozoniser is developped. Irrespective of the current component measured, the effect Δi was found to increase in the order of the mean frequencies of irradiation, *viz.*, red < green < blue < white, although their intensities were 1.1, 1.6, 1.0 2.0, *i.e.*, in a different order. The sum of Δi in blue, green and red was found to be greater than that in white; this has been attributed to the aforesaid saturation effect.

27. Part III. *Joshi-Effect* in Mercury Vapour under Transverse and Longitudnal Irradiation.

B. N. PRASAD, Banaras.

Suggested by the observations of Deo (D.Sc. Thesis, 1947, B.H.U.) and Prasad (*Proc. Indian Sci. Cong.*, 1947, Part III. Phys. Sec., Abst. No. 35) on the influence on Δi in chlorine of the direction of irradiation, a series of observations was made in which Δi in mercury vapour was investigated with irradiation (*a*) tranverse to the ozoniser axis and (*b*) parallel to the axis. It is significant that while the percentage photo-diminution in current under transverse ($\%\Delta i_T$) and longitudual ($\%\Delta i_L$) irradiation differed appreciably (60 and 40 respectively at 0.54*k*V), the corresponding ratio $\%\Delta i_T/\%\Delta i_L$ is approximately constant at 1.5 over the entire range of exciting electrical pressure (0.27 to 1.89*k*V).

28. Part I. Production of the *Joshi-Effect* in Mercury Vapour.

B. N. PRASAD, Banaras.

The above phenomenon, a photo-diminution Δi of the discharge current i, has been observed to be pronounced chiefly in halogens; this is attributed by Prof. Joshi (*Curr. Sci.*, 1947, *16*, 19) to the *electron affinity* of the gas. Joshi has argued that the effect Δi should occur in metallic vapours, whose electron affinity is enhanced by excitation under electrical discharge. This prediction, confirmed strikingly by Joshi's results on metallic and other vapours (*ibid., Presi. Address, Chem. Sec., Indian Sci. Cong.*, 1943) suggested the present investigation with mercury vapour.

The experimental arrangement consisted essentially of Siemens' ozoniser excited by a transformer discharge. In agreement with Joshi's results, Δi was appreciable only above the 'threshold potential' V_m; this was 0.4 and 0.27 *k*V respectively at 50 and 500 cycle frequency of the A.C. supply. In one typical series of observations, the relative *Joshi-Effect* $\%\Delta i = 100\Delta i/i$ Dark was 36.5 at 2.7 *k*V; As the potential was decreased, $\%\Delta i$ rose progressively to a maximum of 71 at 0.54 *k*V, *i.e.* near V_m, as generalised by Joshi. The influence of an increase of the supply frequency is to reduce $\%\Delta i$, *e.g.*, from 69 to 27.5 at 1.1 *k*V by changing from 50 to 500 cycles.

The influence of '*ageing*' under electrical discharge of mercury vapour was remarkably similar to that of bromine (Deshmukh and Sirsikar, *Proc. National Institute Sci.*, *14*, 157) at a constant potential with 50 cycle frequency, it showed within a moderate period a marked diminution in its electrical conductivity; this reached finally a stationary minimum. Sessation of the discharge for a *short* interval, followed by re-excitation at the original potential, restored the conductivity to the previous value, the more completely the longer the interval. The time of exposure to the discharge for producing the minimum steady conductivity; as also the rest period necessary for restoring i to that at the original potential were greater, the higher the exciting potential. Furthermore, the effect of '*ageing*' was to reduce Δi. At 50 cycle frequency and a constant *k*V an increase in temperature increased the conductivity; the corresponding Δi and $\%\Delta i$, however, decreased.

In general, Δi and the corresponding $\%\Delta i$ increased on increasing the relative intensity of light. Thus for *e.g.*, as this last was increased 256 times in a series of observations at 1.3*k*V, the corresponding Δi and $\%\Delta i$ increased 16 times and tended to saturation for large intensities. *Ceteris paribus*, Δi, decreases in the following order: Light of mercury arc lamp > unfiltered white > filtered blue > green > red light.

29. Part II. Production of *Joshi-Effect* in Mercury Vapour with line sources of irradiation.

B. N. PRASAD, Banaras.

By using appropriate filters the two prominent lines *viz.*, 4358Å (blue) and 5461Å (green), from a mercury arc run at 220 volts and 2.5 amperes were used. Their relative intensities, I were respectively 6 and 5; these were far lower than those of the filtered blue and green bands employed earlier. The effect Δi was observed in the ozoniser (*cf.* Part I), excited from 0.54 to 2.70 *k*V, keeping the above light source, 40 cm

distant from the ozoniser axis. It is significant to note that the constancy of the ratio, $\%\Delta i$ blue/$\%\Delta i$ green = (I blue/I green) × (νblue/νgreen) = 1.5, at the various applied *k*V used. This shows that Δi can be specified as a function of the significant frequency and its intensity, especially at *low* values of the latter. At a constant *k*V, as I was increased nine-fold, $\%\Delta i$ also increased practically proportionately. Accroding to Joshi's theory of the effect Δi, the primary change leading to Δi, is the photo-eletric emission from the boundary layer formed under electrical discharge on the walls of the ozoniser; its magnitude depending upon the corresponding light intensity. The resultant change in i, however, is determined by secondary reactions, especially of the collision type. These cause saturation in the effect Δi (Joshi, *Curr. Sci.*, 1945, *14*, 39). This inhibitive influence due to secondary reactions should be comparatively low at small pressures of the excited vapour, as in the present work. The observed linear dependence of Δi in mercury vapour on the corresponding light intensity at *low* values, is, therefore, to be anticipated.

30. *Joshi-Effect* in Mercury Vapour : Influence of Ageing.

B. N. Prasad *and* V. Venkateswarlu, Banaras.

The profound influence of ageing under electrical discharge on the magnitude of the corresponding *Joshi-Effect* was emphasised by Professor Joshi soon after the discovery of this effect. The above factor has been studied in excited mercury vapour which, remarkably enough, shows practically a 100% *Joshi-Effect* under favourable conditions. Three ozonisers A, B, and C were taken charged with mercury vapour at 0.02 mm pressure, A and B containing traces of liquid mercury besides the vapour and C contained only the vapour. Experimental arrangements were made to obtain a nonstop electrical discharge in the ozonisers for any length of time required. The ozoniser A was kept at a temperature of about 200°C for four hours and then cooled. The ozonisers were simultaneously subjected for 424 hours to a constant A.C. excitation potential (50 cycles) of 0.67 *k*V (r.m.s.). The low tesion current was observed at every 12 and some times 6 hours when the ozonisers were in dark and irradiated by 200 watt 220 volt electric bulb. The detector was a T.30 valve coupled inductively with the low tension and used as a double diode by short circuiting the grid and the plate. In ozoniser A the *Joshi-Effect* was observed after 25 hours and thereafter the magnitude of the relative *Joshi-Effect* fluctuated between 57% and 13% and became constant (60%) at the end of the experiment. These fluctuations were due to variations in the current in dark and under light. In the other two ozonisers the *Joshi-Effect* was never observed showing that a preliminary heat treatment might be necessary for the production of the phenomenon. These results of ageing and its influence on relative *Joshi-Effect* are in general support of the activated layer mechanism posutaled by Prof. Joshi.

31. Influence of Light-Frequency and Light-Intensity on *Joshi Effect* in Iodine Vapour.

M. V. Ramanamurti, Banaras.

The dependance of the above factors on the *Joshi effect*, Δi in iodine vapour was investigated in the range of potential V, 200 to 1100 volts (r.m.s) of 50 cycles frequency; with blue, green and red light filters and under relative light intensities I, 1 to 1000.

Δi is +ve at low V, near V_m; and −ve at large V. At a given V, Δi and $\%\Delta i$ (+or−) decrease numerically frequencywise *viz.*, white > blue > green > red. Thus *e.g.*, Δi and $\%\Delta i$ are at 290 V, +43, +860% (white); +35, +700% (blue); +33, +660% (green); +25, +500% (red); and at 400 V, −168, −51% (white); −134, −41% (blue); −70, −21% (green) and −35, −11% (red) respectively. + and $-\Delta i$ are most pronounced under blue and maximum under white; in green and red very small and at larger V, negligible. At a constant V, within a limited range, *viz.*, 300-525 V, Δi (+or−) white < $\Sigma\Delta i$ (+ or −) under various spectral regions; attributed to a saturation-like effect; Δi (+ or −) follows a linear relationship with the wave number, ν_0 corresponding to the effective mean frequency of the filtered region.

+ and $-\Delta i$ increased with I, more rapidly at small, than at large I; tending to a saturation at the latter. In a limited range of I, Joshi-Lakshminarayaniah equation $\Delta i = a\,I^b$ where a and b are constants, was found applicable for − and + Δi also, and the curves, log Δi = log I, tend to be linear in agreement with the above equation.

32. Production of *Joshi Effect* in Geissler Discharges.

D. V. RAMANA RAO, Cuttack.

Joshi Effect, Δi, an instantaneous and reversible current change on irradiation has so far been observed with semi- and full ozoniser discharges. Under favourable conditions as large as -92% relative *Joshi Effect* has been obtained. During the present investigation it has been extended to Geissler discharges also.

The simultaneous sparking between two ring electrodes kept at the bottom in the annular space of the ozoniser separated by 5 mm. produced a marked variation in the discharge current, i_D measured in the ozoniser circuit and in the magnitude of the relative *Joshi Effect*, $-\%\Delta i$, thereof. Thus the values of i_D at 1.6 *k*V with and without the spark are 36.5 and 2.8; the corresponding values of $-\%\Delta i$ being 31 and 86. It is of interest therefore to study the current and the accompanying *Joshi Effect* if any, in the Geissler part of the discharge alone.

Four Siemens' tubes, filled with purified chlorine at 150 mm pressure and containing copper ring electrodes in the annular space were used for the present study. Continuous spark discharge was maintained between the rings by applying D.C. potentials obtained from a point-to-plate rectifier energised by a H.T. Transformer. Measurements of i_D, i_L, Δi and $\%\Delta i$ were made as in the previous cases. *Joshi Effect* has been observed in all the four tubes; the normal negative effect, $-\%\Delta i$ at low voltages rapidly decreases with increase in the exciting potential and tends to become positive at still larger *k*V. Thus for *e.g.*, the values of $\%\Delta i$ at 2.16, 2.7, and 5.4 *k*V are -78, -7 and $+2$ respectively (Tube. 2) An identical behaviour was observed in all the other tubes.

33. Studies on the *Joshi-Effect* in Oxygen: Influence of terminal reversal and the role of high frequencies in its production.

K. S. SARANGAPANI, V. SUBRAHMANYAN *and* K. S. VISVANATHAN, Banaras.

That the *Joshi-Effect*, Δi, *i.e.*, the instantaneous and reversible photovariation in the discharge current, i, in ozonizer type of excitation is of surface origin and occurs chiefly in the H.F. component of the current, as generalised by Joshi, is further supported by studies now reported on the influence of terminal reversal in semi-ozonizers (wire-in-glass cylinder type) containing oxygen at a pressure of 150 mm and excited by (i) alternating potentials of 500 cycles per second, and (ii) unsmoothed unidirectional potentials obtained by using a point-to-plate rectifier tube .

In both types of discharge, the *Joshi-Effect* is found to be markedly greater when the normal connections are reversed, *i.e.*, *when the outer glass cylinder is made the high tension electrode and the central wire earthed.* This confirms the influence of the area of excitation as a determinant of the *Effect*, Δi.

Measurements of the relative *Joshi-Effect*, both in the total discharge current and in the L.F. part (the H.F. being filtered off through a by-pass Capacity, or damped by a serial high resistance), give larger values for the *Effect* in the total current than in the L.F. region. This associates Δi with the high frequency component of i. The above feature becomes more pronounced on terminal reversal. Simultaneously, it is also observed that the proportion of $i_{H.F.}$ is greater under *reversed connections*, giving thereby additional evidence that the H.F. constitutes the major seat of Δi.

It is also inferred that increasing the area of the excited surface favours the production of a greater proportion of H.F. and hence larger *Joshi-Effect.*

34. Effect of Electron bombardment on the After-glow of Active nitrogen

V. SUBRAHMANYAN *and* K. S. SARANGAPANI, Banaras.

A study has been made of the effect of electron bombardment of active nitrogen on the life (duration) and intensity of its after-glow. The apparatus consisted of a discharge tube in which active nitrogen was produced and a spherical observation bulb with a simple thermionic emitter introduced between the two. This last contained a heating filament of nichrome wire coated with BaO and an Al plate fixed opposite to it at a distance of about one cm. A slow stream of pure dry nitrogen at a pressure of

5 — 6 mm was drawn through the discharge tube which was excited by an induction coil with a spark gap in series. The life (in seconds) and the intensity (visual) of the after-glow in the observation bulb were noted. With the thermionic emitter at just dull-red heat and the plate at an appropriate positive potential, thermions were produced which bombarded the active nitrogen passing through the bulb. As a consequence, the intensity of the after-glow, as observed in the last bulb, was found to have decreased markedly while its life was not appreciably affected.

35. Non-dependence of *Joshi-Effect* on Selective Light absorption in Mercury Vapour.

V. VENKATESWARLU, Banaras.

In view of Professor Joshi's suggestion, that the magnitude of *Joshi-Effect* may be independent of selective light absorption, a spectroscopic study of the problem was undertaken in mercury vapour under *optimum* conditions for the production of the phenomenon. Mercury vapour at 0.02 mm of mercury contained in a Siemens' type ozoniser as modified by Joshi was excited by A. C. potentials of 50 and 500 cycles over a range of 0.2 to 0.6 *k*V (r.m.s.). The L.T. current was measured by a sensitive mirror galvanometer actuated by a double diode (6H6 RCA). Observations were made when the ozoniser was irradiated transversely and longitudinally to its axis with a 200 watt 220 volt electric bulb, mercury arc lamp and a hydrogen discharge tube, after securing constant conditions by ageing under electrical discharge. The magnitude of the relative *Joshi-Effect* when irradiated longitudinally was 98%, 93% and 15% with mercury arc lamp, electric bulb and hydrogen discharge tube respectively.

The absorption spectrum of mercury vapour in the normal and in the excited conditions was studied in the visible and in the ultra-violet, employing the electric bulb, mercury arc lamp and hydrogen discharge tube as light sources. No difference could be found between the absorption spectrum of the normal and excited mercury vapour showing that the absorption is not increased by the passage of the discharge. This was ascribed to the low current density of the discharge which was less than one micro ampere/sq. cm and is in agreement with the work of Metcalfe and Venkateshachar (*Proc. Roy. Soc.*, Vol. 100A. *pp.* 149, 1922), and L.A. Turner and K. T. Compton (*Phys. Rev.* Vol. 25, *pp*, 606, 1924). The independence of Δi with selective absorption now observed in mercury vapour is in accord with the results in iodine vapour (to be published shortly) obtained by Dr. K. V. Rao working in this laboratory.

36. The Rate of Atmospheric Ionization and the Air-Earth Current at Poona.

K. S. AGARWALA, New Delhi.

In this paper, the atmospheric-electric data of potential-gradient, electrical conductivity, concentrations of nuclei and small ions and mobilities of the small ions, published in some earlier papers (J. M. Sil, Sil and Agarwala, Agarwala) from the Indian Meteorological Department, have been made use of to determine the rate of ionization and the air-earth current at Poona at 10 hrs. I.S.T. The graphs for the rate of ionization and the negative air-earth current show fair similarity. The average value of the rate of ionization is estimated to be 14.7 ion-pairs/c.c./Sec. and that of the negative air-earth current 3.7×10^{-1} E.S.U. A comparison of the observed values with the computed results according to (i) the linear recombination law and (ii) the square root law for conditions of ionization has also been attempted.

37. On the Gustiness of Wind and Occurrence of Gusts at Vizagapatam.

K. S. AGARWALA, New Delhi.

The paper summarises the results of a study of the gustiness of wind and of the occurrence of gusts at Vizagapatam, based on the analysis of 3 years' records of the Dines Pressure Tube anemograph with its head 56½ feet above ground. Tables showing the diurnal variation of gustiness for the twelve months of the year are given

and briefly discussed. Frequencies of the times of occurrence, velocities and directions of the gusts are also given and their chief features are described. A table showing the highest gust recorded in each one of the three years is also included.

38. Mahajan's maximum and minimum Hygrometer.

L. D. MAHAJAN, Patiala.

In continuation of his pervious research work on Hygrometry, and his inventions of Mahajan's Optical Hygrometor, and Mahajan's Humimeter, the author has now invented another new intrument namely the Mahajan's Maximum and Minimum Hygrometer. It is a kind of Hygrometer which records the Maximum percentage humidity as well as the Minimum percentage humidity of the atmosphere for any period.

It is made on the principle of the Mahajan's Humimeter, but has two more balancing rods, one on each side of the rod of the indicator. These additional rods do not have any pans containing the absorbing material but merely thick heads to balance their corresponding pointers on the dial. These pointers are pushed aside by the indicator, when it moves on the dial on either side. They remain wherever they are pushed to and indicate the maximum and minimum percentage humidity on the dial.

The details of its construction, theory and working are given in this paper.

39. The Influence of Weather Conditions on Long Distance Short-Wave Transmission.

N. S. SUBBA RAO *and* Y. V. SOMAYAJULU, Waltair.

Field strengths at Waltair, of signals radiated from Madras, Calcutta and Bombay stations of the A.I.R. on the 41 and 49 metre bands, have been studied over a period of 7 months. The measurements have been made between 7-30 hrs to 9-00 hrs I.S.T. daily. The day to day variations of the received signal strengths are presented, month by month, in the form of graphs and discussed.

The study of these curves shows that :

1. During the wet season there is a definite relationship between the field strengths of the received signals and the percentage humidities in the atmosphere along the path of the wave—a rise or fall in humidity producing a corresponding fall or rise in the received signal strengths.

2. Further, these effects are more pronounced when the percentage humidities are round about 85%.

3. In cases where the humidities are much lower, there appears to be no relation between these two quantities.

This abnormal transmission, especially during wet season, is traced to reflection at low levels, produced by clouds or zones of condensation or by water vapour molecules themselves.

40. Fermi resonance in the spectra of Benzene.

R. K. ASUNDI *and* M. R. PADHYE, Banaras.

The well-known Fermi resonance phenomenon in the Raman spectrum of benzene naturally occurs also in the absorption fluorescence and emission spectra of the molecule. Particularly in the emission spectrum the phenomenon can be traced upto a loading of three more vibrational quanta of the totally symmetrical 992 Cm^{-1} on each of the fundamental Fermi doublets. The effect of anharmonicity on the spacing of these doublets is discussed.

41. On the Luminescence of Diamond.

V. CHANDRASEKHARAN, Bangalore.

Fluorescent diamonds have the remarkable property of storing up energy under ultra-violet excitation a portion of which is emitted as phosphorescence. The rest of

it is emitted, however, only on heating the diamond or on re-illuminiating it with visible light. The energy of activation produced is very high when ultra-violet containing only radiations below λ 3000 is used for irradiation while the intensity of fluorescence excited is feeble. While the diamond is fluorescing under this ultra-violet, irradiation of the diamond with intense beam of red light causes the sudden release of the large stored up energy. Hence intensity of luminescence of diamond viewed through a complementary filter increases appreciably above the original value and in a second or two comes down again.

42. Rayleigh's condition of resolution and relative intensities of components.

G. B. DEODHAR, Allahabad.

The late Lord Rayleigh prescribed the condition of resolution of a double line which is at present universally accepted. In arriving at this condition, Rayleigh assumed that the intensities of the two compontents are perfectly equal. If inequalities in intensities of the two components are taken into account resolution becomes uncertain if Rayleigh's condition is accepted This is shown by plotting curves with intensity ratios 1.2 and 1.4. If the prescribed distance between the principal maxima is doubled this uncertainty vanishes. It is therefore suggested that for the sake of clarity this double distance should be universally taken as the criterion of resolution.

43. Emission Spectrum of Toluene.

M. R. PADHYE, Banaras.

The spectrum of toluene excited by a transformer discharge in flowing vapour consists of a continuous band in the body of which a large number of discrete bands are situated. Thirty four of such discrete bands are measured. Most of them are counterparts of absorption bands. But a few have no counterparts in absorption. An analysis of the observed bands is proposed. The continuous band appears to possess a rather sharp short wave limit which coincides with the origin of the discrete band system. It probably represents the excitation of the phenyl radical.

44. Atomic lines in flame spectra.

V. Y. RAJOPADHYE *and* B. K. VAIDYA.

The atomic lines observed in flame spectra usually correspond to an excitation energy of about 5 e. volts. Yet some cases are known where even an energy of 6 or 7 volts seems to be available in the ordinary flame sources, such as the Bunsen flame or the spirit lamp flame. These lines mostly occur as transitions of the excited atom to the ground electronic state, and quite many of them are the " Raies Ultimes " of the elements. Since a large number of lines, down to the ultraviolet region near λ 2300 Å, are easily obtained in the flame spectra of the elements, Arsenic, Antimony, Bismuth, tin, iron and copper, a detailed study has been made of the levels involved in the spectra of these elements.

The spectra of Arsenic, Antimony, Bismuth arise out of similar electronic transitions between the doublet and the quartet terms. The number of lines, occuring in the flame-source, increases from Arsenic to Bismuth as more terms occur within the limits of available energy, and as the ionization potential decreases. The highest level excited for antimony is 6.1 volts. Bismuth 6.3 volts and arsenic 6.7 volts above their respective ground levels. Tin also shows a number of lines, arsising out of singlet and triplet terms, the highest level being 5.3 volts. Iron is known to give a rich spectrum of lines, when iron chloride is introduced in the oxy-hydrogen flame but to produce a line spectrum of iron by using a mild flame it is found that a halide salt of iron must be formed in the flame by the interaction of the metal with a halogen compound. Prominent groups of lines are observed in the spectrum near λ λ 3748, 3581, 2756, 2520, 2480Å., and require energies varying between 3 to 5 e. volts.

In the case of copper, there are two lines at λλ 4651 Å, and 4275 Å, which are known to be due to transitions $^4_D \rightarrow ^4_P$ and $^4_D \rightarrow ^4_F$. As these transitions involve negative

energy levels which require a fairly high energy of excitation their presence in the flame has been explained by Singh (*Current Science* 11, 330, 1942) as due to (1, 0), and (0, 0) bands of CuH molecules, the actual wavelengths of which are λλ 4648 Å. and 4280 Å respectively. Apart from the small discrepancy in the wavelengths, the arguments in favour of the atomic transitions are (i) possibility of excitation of energy by means other than thermal; (ii) greater transition probability between the levels according to the principle laid down by Meggars; (iii) the terms involved belong to a scheme of energy levels arising out of the excitation of the atom with $3d^9\ 4s^2$ configuration. The energy of excitation calculated from the lowest level of this configuration (metastable state) works out to be only 6.3 volts which is obtainable in the flame sources.

45. The Absorption Spectrum of Ammonium Chloride in the near Infra-Red.

K. G. RAMANATHAN, Bangalore.

The Infra-red absorption spectrum of ammonium chloride has been investigated using crystals of four different thicknesses, in the region of transmission of the quartz prism. Maxima of absorption are observed to be present at 0.95μ, 1.11μ, 1.35μ and 1.63μ. All of these except the last one have been recorded for the first time. Besides, a band at 2.2μ observed earlier by Coblentz, has been resolved into three separate maxima at 2.12μ, 2.26μ and 2.40μ.

46. Band Spectrum of Zinc Iodide Molecule.

C. RAMASASTRY, Waltair.

The emission band spectrum of diatomic zinc iodide molecule as excited by a H.F. oscillator is found to consist of five discrete band systems and six continua in the wavelength region 6500Å to 1950Å. The vibrational analyses of four of these systems has given a common lower state with the vibrational constants $we'' = 224.5$ cm.$^{-1}$ and $xe''we'' = 0.8$ cm.$^{-1}$. There is also evidence of predissociation in the upper states of two of the analysed band systems.

The existence of Zinc Isotope with mass number 68 is confirmed spectroscopically.

Almost all the electronic levels of the molecule, which are established from experimental results can be derived theoretically from considerations of electronic configurations in the molecule and the energy states of the individual Zinc and Iodine atoms constituting the molecule.

47. Extension of the Asundi bandsystem, $a'^3\Sigma \rightarrow a^3\pi$, of CO.

SATYA NARAIN GARG, Banaras.

In ordinary discharges through CO tubes it is very difficult (rather practically impossible) to photograph any more of the bands of the above system than those observed by Asundi and supplemented by others so far, and which number about twenty. In a tube containing $SnBr_4$ along with CO_2 the author was able to photograph well-developed bands of the system. The newly added bands number thirtynine. The highest v' and v'' levels involved are 27th and 9th respectively.

48. Formation of Complex Compounds of Lead Nitrate and Potassium Nitrate.

P. N. SHARMA, M. R. NAYAR *and* J. R. SARAF, Lucknow.

Physico-chemical measurements indicate the formation of the complex compound $K_4[Pb(No_3)_6]$ when aq. solutions of $Pb(No_3)_2$ and $4KNo_3$ are mixed together. Raman Spectral evidence is sought to be obtained for the formation of this new compound.

49. A Critical Pressure Effect in Collisions of the Second Kind.

N. R. TAWDE, Bombay.

Phenomena of close resonance in collisions of the second kind is often met with in atomic spectra as a result of coincidence of energy levels of colliding partners—atom and atom. When however, energy transfer takes place in an inelastic way between an atom and a molecule, the spectrum of the latter is excited. Swan bands of C_2 were studied in this way by Tawde and Desai in the presence of argon as foreign gas. They obtained a selective behaviour for the bands at a certain pressure among the many that were investigated, but no explanation was offered for the same. An attempt has been made in this paper to explain the behaviour on the basis of Stern-Volmer condition. This enables the estimation of the lifetime of the excited state $3\pi_g$ of the C_2 molecule and to relate the activation and deactivation with time defect $(\tau - t)$ where τ is the life-time of the excited state and t is the time between successive collisions.

50. The Dissociation Energy of C_2.

N. R. TAWDE, Bombay.

There have been many divergent estimates of the dissociation energy of C_2 molecule. The value of 5.5 *e.v.* has been seriously questioned by Herzberg, whose estimate, following the assignment of the high pressure band of C_2 to swan system at $v' = 6(3\pi_g)$ state comes to a lower value, viz. $D(C_2) = 3.6$ *e.v.* According to Gaydon's contention, however, this value is a very low estimate and he believes that any value below 4 *e.v.* is very unlikely. Attempt has been made in this paper to apply the intensity distribution to obtain a measure of almost the limit of dissociation by a graphical method using observed statistical weights. The value so obtained is 4.2 ± 0.2 *e.v.* which, though closely approaching the dissociation energy, may be somewhat a lower limit, thus confirming the view of Gaydon.

51. Abnormal spectral broadening phenomenon in condensed spark under Glycerine.

N. R. TAWDE *and* K. GOPALKRISHNAN, Bombay.

It is found that the under-glycerine spark gives, besides the molecular spectrum of C_2 (Swan), CO (Angstrom), and CH, atomic lines due to H, O and C. They undergo variation in intensity and structure according to the variation in electrical conditions of excitation.

When the investigation was carried out under controlled conditions of electrical excitation, the broadening of H lines was particularly marked, in which there was an abnormal effect for Hβ-line. This was studied with different degrees of condensation and voltage across the spark. The observed results have been compared with those of previous workers and discussed in the light of available knowledge of the mechanism.

52. Polarisation of Fluorescence and Lifetime of the Excited States.

N. R. TAWDE *and* N. RAMANATHAN, Bombay.

The measurement of polarisation of fluorescence affords a method of computing the lifetime of excited states. The lifetime has been found not to vary with viscosity or the temperature of the medium. But it varies with the concentration of the dissolved substance. It is to be noted that the general considerations leading to the derivation of lifetime for different conditions of viscosity and temperature do not help us in obtaining the lifetime for different concentrations. The latter are explainable by the application of the principle of quantum-mechanical resonance involving the migration of energy between the excited and unexcited molecules.

53. The study of Carbon Spectra in 50 cycles (uncondensed) Discharge through CO.

N. R. Tawde *and* M. K. Menon, Bombay.

Excitation factors in the electrical discharge through CO to produce the Swan or Angstrom bands as stated by Pretty, Merton and Johnson and the present authors(*Abst. Ind. Sc. Cong.* 1948) do not give a defined picture of the conditions necessary as regards condensation or pressure. As a result of recent investigations in this laboratory Swan bands have been obtained even in 50 cycles (uncondensed) discharge through CO at high pressures. This needs explanation from the standpoint of excitation by collisions of second kind or by damped electrical oscillations and related to the capacity effect. Attempt has been made to analyse these aspects.

54. Striking Potentials in H.F. Discharge.

N. R. Tawde *and* G. K. Mehta, Bombay.

From the results of our study of H.F. discharge in hydrogen and the results of the previous workers on the striking potentials at different pressures, it is possible to interpret the nature of the striking potential curve ($V - p$), for different pressure regions. At very low pressures of the order of 10μ, it seems that the secondary emission from glass walls need only be considered but at pressure round about 0.5mm of Hg., ionisation by electron impact becomes appreciable. At pressures higher than 0.5mm ionisation by electron impact is mainly operative. The theoretical aspects of the motion of the electron in the h.f. field at different pressures, depending upon the size of the discharge vessel and the frequency of excitation, considered along with the experimental results, allow definite conclusions about the striking mechanism of the h.f. discharge.

55. Relative Effects of Oxygen and Argon on the Nitrogen Band Spectra.

N. R. Tawde *and* K. S. Korgaokar, Bombay.

The greater suppression of nitrogen 1st positive system relative to others in the spectrum of discharge in air has been invariably attributed by some workers like Gaydon to the presence of 20% oxygen constituent of air. On the other hand according to Johnson and Tawde and Patanker, a trace of inert gas like argon is enough to bring about a large redistribution of intensity. Now among the rare gas constituents of air argon is more predominant (though much less in comparison to oxygen). So we might expect it to cause a change comparable to that of oxygen. Experiments have been in progress in this laboratory to distinguish between the two. From the results it is possible to compare the magitude of the effect of oxygen with that of argon.

56. An Interpretation of Eddington's Fundamental Theory.

Brij Nath, Delhi.

Eddington has introduced two concepts of fundamental importance, the observables and the measurables, but as he works mainly with the measurables, he omits to define the other term precisely. The author gives a symbolic definition based on the Theory of Groups and later interprets the symbolism to deduce most of the well established principles of modern physics, in particular the following:— The expansion of universe, the end of the world, the concept of entropy, the dual nature of matter and radiation, Dirac's hole theory, the occurrence and the formation of radio-active substances, and Heisenberg's principle of uncertainty.

The author then examines the foundations of the Relativity Theory and the Quantum Theory and shows that the problem of Einstein's static universe can be solved on the basis of either theory and the results can be compared leading to a combination of two theories. Incidentally he deduces that there are two kinds of time and that Lorentz invariance is possible with respect to one of them only, and also that for systems on the atomic scale time flows unevenly or that time has only statistical significance.

. In conclusion the author indicates briefly some of the philosophical problems to which the theory can be applied.

57. The Isothermals of Potassium Chloride at High Temperatures.

B. DAYAL, Banaras.

An approximate force model $\phi = -\frac{\alpha e^2}{r} + 6\,be^{-r/\rho}$ has been used to evaluate the free energy and the pressure of the potassium chloride lattice for different values of the volume and the temperature. The Raman theory of crystal vibrations has been used to calculate the thermal part of the pressure. This has been done by evaluating $\frac{d \log \nu}{\partial v}$ for the various frequencies and then taking a statistical average of its values. The average of the frequencies has been used to calculate the thermal energy. It is found that the isothermal for 850° K has a minimum which lies very nearly on the axis of the zero pressure. This temperature which marks the position of the instability of the lattice thus comes out to be about 20 percent lower than the melting point. Preliminary calculations show that the difference between the two temperatures will be less marked if a more accurate force model is used for the calculation of the static part of the pressure.

58. Ionic Nature of Alkali Halides in Solid State.

S. K. K. JATKAR *and* (MISS) S. B. KULKARNI, Bangalore.

The ionic character (i) of alkali halides in solid state have been calculated by applying the relationship $V = A\left\{ i\frac{e^2}{r} + (1-i)\sqrt{D(A-A)(B-B)} \right\}$ where U, A, i, D(A—A), D (B—B), r and e are the crystal energy, Madelung constant, ionic character in crystals, covalent bond energies, crystal distance and electronic charge respectively. The calculated ionic charaters for solids are 82%, 86%, 86% in the case of NaCl, NaBr, NaI and 85%, 86%, 86% in the case of KCl, KBr, KI and that of CsI is 90%. Ionic character (i) of alkali halides in vapour state is lower than in solid owing to decreased internuclear distance (r), ($ia r^2$). The Born empirical and variable factor n in the equation $U = \frac{Ae^2}{r}\left(1 - \frac{1}{n}\right)$ is actually due to partial covalent character of the bonds in the crystal.

59. A Simple Design Automatic Cloud Chamber.

S. RANGA IYENGAR, B. A. KRISHNASWAMI RAO *and* C. K. SUNDARACHAR, Tumkur.

A simple type of continuous working cloud expansion chamber, consisting of a filter pump, which functions both as a compressor and as an evacuator and a conventional Wilson expansion chamber with an interposed "dumb-bell ball valve" system is described. The outfit can be assembled with materials available in any ordinary laboratory. Any desired expansion ratio, to get well defined nuclear radiation or cosmic ray tracks, can be got by suitable adjustment of the input water supply to the aspirator pump, the exit water at the compressor and the volume of the exhaust, into which the compressed air in the Wilson chamber adiabatically expands.

60. Finite Pure Flexure.

B. R. SETH, Delhi.

One of the fundamental results in the theory of elasticity is the Bernoulli-Buler law of pure flexure which says that when a beam is bent by terminal couples the bending moment is proportional to the curvature of the central line. This law is widely used in the theory of flexure of prisms, continuous beams and bending of plates and rods. In the case of plates it is known that, if $2b$ is the thickness of the plate and ρ the radius of curvature in the plane of bending, then for small values of (b/ρ) the moments of the applied couples M_1, M_2 per unit legth applied to the straight and circular edges are (D/ρ) and $(\eta D/\rho)$, η being Poisson's ratio and D the flexural regidity of the plate. It will, therefore, be of interest to know what form these relations take for finite deflections when (b/ρ) is not small.

If ρ is the curvature of the middle surface, the theory of finite strain gives to the second order of (b/ρ)

$$M_1 = \frac{D}{\rho}\left[1 - \frac{1}{15}(2-6c+c^2)\frac{b^2}{\rho^2}\right]$$

$$M_2 = \frac{-\eta D}{\rho}\left[1 - \frac{1}{60}(13-7c)(1-c)\frac{b^2}{\rho^2}\right]$$

61. Experimental and Theoretical Aspects of the Pendant Drop Method of Surface Tension.

N. R. TAWDE *and* K. G. PARVATIKAR, Bombay.

Wilhelmy's original treatment of the pendant drop has in recent years received new orientation as a result of the work of Andreas, Hauser and Tucker defining precisely the size and shape of the drop. Very recently Fordham has developed the theory of the method by which the measure of shape and size can be obtained very accurately and a table of the values of 1/H as a function S has been drawn up. Improved experimental technique has been set up in this laboratory to obtain a measure of S and 1/H by carrying out linear measurements on the photographed enlarged image of the drop. These enable comparison to be made with Fordham's Table.

62. Construction of a New Combined Vacuum Furnace and Mass Spectrometer for Universal Use.

B. N. SRIVASTAVA, *and* V. N. SAHARIA, Allahabad.

In this paper the design and construction of a new combined vaccum furnace and mass spectrometer has been described in detail. The demountable vacuum graphite furnace already in use in this laboratory has been suitably modified so that the ion being effusing from the graphite furnace and travelling in vacuum passes through a 60° Nier type mass spectrometer. The ion beam is first made uniform through acceleration by a high applied voltage and then traverses a homogeneous wedge-shaped magnetic field produced by an electro-magnet with suitably designed pole pieces. By selecting suitable values for the magnetic field and the acclerating voltage the geometrical condition of magnetic refocussing can be satisfied for a particular divergent ion beam and this beam can be collected by a Faraday cylinder in a certain fixed position. This device thus gives us both resolution and refocussing. The set up can be used to collect any ion in the same Faraday cylinder by adjusting the ion accelerating voltage and (if necessary) the magnetic field. Thus ions of different masses could be separately collected and measured. The apparatus is bound to be of great utility in future ionic and thermionic investigations as it provides a simple universal method of producing separately collecting and measuring ions of all substances.

63. Studies on Band Spectra of Some Molecules.

SATYA NARAIN GARG, M.SC., B.SC. (HONS.), Allahabad.

With the object of obtaining CBr and Cl emission bands the author photographed the spectrum of discharge through CH_3Br, CH_2Br_2 $CHBr_3$, and CH_3I both in the visible and the ultraviolet regions. An attempt to systhesise CBr_4 was also made and uncondensed discharge through its vapour was observed. Spectra of HBr and Br_2 were also photographed.

In HBr a continuum, hitherto unknown was obtained starting from about 2600 Å and gradually fading towards the absorption limit of quartz. In other molecules several continual and discrete bands have been photographed whose measurements and study are in progress. Full data will be reported in due course of time.

64. Spectrum of Discharge through $TiCl_4$ Vapour.

SATYA NARAIN GARG, M.SC., B.SC. (HONS.), Allahabad.

The author photographed the emission spectrum of uncondensed discharge through $TiCl_4$ vapour both in the visible and ultraviolet regions. Several new band systems appear to be present in the spectrum of the discharge through flowing vapour. In the discharge through stagnant vapour at low pressure a continuum has been recorded starting from about 3700 Å and going up to the absorption limit of quartz. The outstanding characteristics of this continuum are its purity (being free from even OH band at 3064 Å) and uniformity of intensity. Analysis of the bands is in progress. A full report will be made in due course of time.

(A solid dissociation product of the discharge through $TiCl_4$ gave a slight coating on the quartz window of the tube. The coating was just perceptible and was practically transparent to visible light, but, absorbed totally all light below about 2800 Å. The chemical identification of the said product will be shortly undertaken.)

65. Magnetic Properties of Cobalt Salts at Low Temperatures.

BHAGAWATI CHARAN GUHA, D.SC., Calcutta.

Measurements have been made on a number of cobalt salts from room temperature down to about 80°K. Though the CO^{++} ion is in the F-state as the Ni^{++}, the Stark pattern for a given field for Co^{++} is inverted with reference to Ni^{++}. As a result of this inversion the lowest level of Stark pattern which is a singlet in Ni^{++}, will now be a triplet. This makes the magnetic behaviour of Co^{++} much more complicated than that of Ni^{++}.

The values of the principal magnetic moments of the cobalt Tutton salts and the general trends of their temperature variations suggest that the rhombic fields in them should be of nearly the same magnitude. An estimate has been made of this field, and it is found that in cobalt sulphate heptahydrate and cobalt selenate hexahydrate the rhombic fields are definitely greater than in Tutton salts.

In the selenate the p^2 value corresponding to the lowest of the three principal susceptibilities falls down so rapidly with decrease of temperature that this susceptibility actually shows a maximum at about 130°K, below which temperature the susceptibility decreases with the lowering of temperature.

66. A note on a simple form of Voltage Stabiliser.

N. K. SAHA, B. S. CHANDRASEKHAR *and* M. K. SUNDARESAN, Delhi.

A simple form of voltage stabiliser for the range 600—2000 volts, suitable for use with G.M.—counters is described. The stabilisation is effected with the help of gas-ionisation in a air discharge tube of variable pressure connected in parallel to the transformer output. At a stabilised voltage of ~1500 a deviation of ~2.5% was observed when the transformer output was varied between 2000 and 3500 Volt. As such a wide variation of the transformer output is not likely to occur in practice, the stabilisation

attained is generally very satisfactory. Simplicity of the electrical circuit, ease of operation in changing the range of stabilised voltage, good accuracy and low cost are the main features of the method.

67. Dielectric Dispersion of Polar Solutions.

S. K. K. JATKAR *and* B. R. Y. IYENGAR, Bangalore.

An expression has been derived for the dielectric dispersion of polar solutions taking into consideration the individual orientations and relaxation times of the molecules of the polar components. Oncley's semi-empirical relationship which has been applied to solution of proteins is shown to follow from the new equation, after effecting certain valid approximations. It has also been pointed out that the equation used by Collie, Hasted and Ritson to interpret the dispersion of aqueous ionic solutions is erroneous.

68. Dielectric Dispersion of Water.

S. K. K. JATKAR *and* B. R. Y. IYENGAR, Bangalore.

The data of recent measurements on the dielectric constants and loss angle of water at different temperatures and frequencies has been used to calculate the critical frequency and molecular radius of water, by applying the new equation for dielectric dispersion of polar liquids. A temperature independent value of 1.4 Å is obtained for the molecular radius in agreement with the accepted value.

69. A New Linear Time Base Circuit.

MISS LILY MATHEW *and* N. B. BHATT, Bangalore.

There are several known methods by which a voltage varying linearly with time may be obtained from the exponential charge or discharge of a condenser through a resistance, some of which are used in the time base circuits of commercial Cathode Ray Oscillographs. While such circuits give sufficient linearity in practice (N. B. Bhatt, Current Science, XIV, 166, 1945) it has been shown by Clarke (Wireless Engineer, XXVI, 256, 1944) that theoretically absolute linearity is unattainable by them. A new type of circuit has been evolved by the Authors which under easily attainable conditions is shown to have a linearity approaching the ideal case. In practical rig-up the circuit takes the form of a constant charging circuit with a thyratron trigger; the exponential voltage output is then introduced into a vacuum tube stage so arranged that its output voltage is truly proportional to the logarithm of the input. Such a logarithmic stage was first described by Meagher and Bentley (R.S.I.,VII, 339,1939) and later investigated by D. L. Subrahmanyam of this Laboratory (Electrotechnics, March, 1948). This is followed by a two stage direct coupled amplifier whose output is finally applied to the horizontal plates of a cathode ray oscillograph. Preliminary results have been very promising in as much as the circuit shows a decided improvement in linearity over that achieved by commercial instruments besides offering certain other advantages. The work so far has been confined to the frequency range of 50-10,000 c.p.s. but its extension on both the low and high frequency sides is under progress. The advantages and the requirements of the circuit are discussed.

70. Influence of the Ozonizer-size on the Joshi Effect in Chlorine.

P. G. DEO, Saugor.

Following the observations of Joshi and coworkers (*Proc. Ind. Sci. Congr.* pt. III, 1943-47) that the walls of the discharge vessel play an important part in the production of the *Joshi Effect*, the influence of the ozonizer-size on the magnitude of the effect has been investigated. Experiments were carried out at Banaras with ozonizers S_1, S_2, S_3, S_4, and S_5, similar in all respects but of effective lengths 19.5, 15.8, 7.9, 3.1 and 1.9 cms. respectively. The results show that the magnitudes of Δi the *Joshi Effect*, are in the order $S_1 > S_2 > S_3 > S_4 > S_5$, *i.e., ceteris paribus*, the magnitude of the phenomenon increases by increasing the exciting surface.

The *wall effect* and other allied phenomena which are of general occurrence in a discharge reaction have been briefly reviewed. Evidence obtained so far shows that the solid-gas interface and its immediate neighbourhood play an important part in the production of this phenomenon.

71. Influence of Intensity of Irradiation on the Joshi Effect in Chlorine.

P. G. Deo, Saugor.

Earlier results employing distance-variation method (Deo, *Ind. J. Phys.*, 1944, *vol.* 18, *p.*84) have shown that the magnitude of the *Joshi Effect* depends markedly on the intensity of irradiation. This has been now studied with an improved technique of intensity variation, *viz.* a nicol-pair, in which the intensity of the transmitted light varies as $\cos^2\alpha$, α, being the inter-nicol angle. The results obtained at Banaras show that the relationship of % Δi, the percentage *Joshi Effect*, (or even Δi since i dark was kept constant) towards α, cos α and $\cos^2\alpha$ is not linear. The $\%\Delta i$—I (*i.e.* $\%\Delta i - \cos^2\alpha$) curve is found to be concave towards the intensity-axis which appears to be the characteristic of the phenomenon. Over the restricted range it is observed that the variation of the *Joshi Effect* with the incident intensity may be represented by $\%\ \Delta i = aI^b$. This has been considered from the well known Freundlich isotherm $x = mp^n$ where X, is the amount of the gas absorbed, p is the gas pressure, and m and n are constants. The ratio *Joshi Effect*: light intensity, decreases with the intensity. This has been compared with some heterogeneous photo-reactions which show similar dependence presumably due to saturation.

72. Magnetic Behaviour of Potassium Ferricyanide from Room Temperature to liquid Air temperature.

Bhagawati Charan Guha, D.Sc., Calcutta.

The Fe^{+++} ions in potassium ferricyanide crystal is *covalently* co-ordinated with its neighbours. Such a binding will conduce to a much closer approach between the central ion and the surrounding atoms, and hence to a much larger crystalline electric field in the centre than will be the case in the ionic salts.

L. C. Jackson (1933) measured by a different method the principal susceptibilities of the ferricyanide from room temperature to 75°K. Though there is a general agreement between Jackson's values and ours, this does not extend to the details. For example, the $x_1 - x_3$ values rises very sharply, reaches a maximum at about 120°K, and falls equally rapidly on further lowering of temperature. This interesting result has been obtained by us as we measured the anisotropies directly. Our p_s^2 values are practically independent of temperature in the region of 120° to 80°K, whereas Jackson's values come down rapidly with temperature even in this range. Again the numerical values of the principal moments obtained by us are consistently lower than Jackson's. It should be mentioned that both Jackson's values and ours fit well with the theoretical calculations of Howard (1935), based on some reasonable assumptions for the fields over the whole range of our measurements.

36th INDIAN SCIENCE CONGRESS, ALLAHABAD 1949

SECTION OF CHEMISTRY

PRESIDENT : P. B. GANGULY, D.Sc., F.N.I.

Abstracts

Inorganic Chemistry

1. Oxidation Potential and Instability Constant of Ethylenedibiguanide Complex of Tripositive Silver.

PRIYADA RANJAN RAY *and* DEBABRATA SEN, Calcutta.

Oxidation potential of the system, complex silver ethylenedibiguanide nitrate (with tripositive silver) and silver nitrate, has been measured in water and acid solutions at room temperature under different conditions of concentration of the constituents [illegible] Hand potentiometer. From these the instability constant of the complex tripositive silver ion has been [illegible]. The standard oxidation potential of the argentic-argentous system was assumed, after necessary temperature correction, to be more or less equal to the E.M.F. obtained by Luther and Pokorny (*Z. anorg. Chem.*, *57*, 1908, 290) at 25°C. for the system,

$$Pt,\ Ag_2O_3,\ Ag_2SO_4\ sat.\ |\ 0.5\ \frac{H_2SO_4}{2}\ ,\ H_2,$$

which gave a value of 1.74 volt. Though this assumption was more or less an arbitrary one, nevertheless it presumably shows that the actual value cannot be lower than this. An order of the instability constant of the complex can thus be obtained from the results of the measurements made. The value of this instability constant was found to be of the order of 10^{-23} in water solution and of the order of 10^{-25} in acid solution, showing thereby that the presence of H^+-ions catalytically retards the degree of dissociation of the complex ion and hence lowers the value of the instability constant. This is also supported from a study of the rate of decomposition of the complex ion in water and acid solutions respectively. The dissociation of the complex is followed by a slow decomposition reaction, which is superimposed upon the former and is practically irreversible under the condition of the experiments. The reactions that occur, are shown below :

$$[Ag\ Et(BigH)_2]^{3+} + 2H^+ \longleftrightarrow Ag^{++} + Et(BigH_2)_2^{++}$$

$$Ag^{3+} + H_2O \longrightarrow Ag^+ + H_2 + 1/2\ O_2$$

The value of the instability constant, K, for the complex may be compared to that of the cobaltammine complexes and that of cobaltous tertrammine and cadmium tetrammine studied by Lamb and Larson (*J. Amer. Chem. Soc.*, *42*, 1920, 2024), and which are of the order of 10^{-34} , 10^{-5} and 10^{-7} respectively. This leads to the conclusion that the quadri-covalent silver ethylenedibiguanide nitrate is a quite stable complex yielding in its molar solution an argentic (Ag^{3+}) ion concentration of the order of 10^{-13}.

$Et(BigH)_2$=one molecule of ethylenedibiguanide $=C_6H_{16}N_{10}$.

2. The Magnetic Study of Cadmium Salts.

MATA PRASAD, S. S. DHARMATTI *and* R. A BHOBE, Bombay.

The magnetic susceptibilities of Cadmium salts of organic and inorganic acids prepared in a chemically pure state, have been measured on a modified form of Gouy's balance. From the mass susceptibilities thus obtained, the ionic susceptibility of Cd^{++} has been determined by the method of averages utilising the

various values of anions given by different authors, and has been compared with the theoretical values. It is observed that the ionic susceptibility of Cd^{++} deduced from the salts of organic acids is higher than that derived from the salts of inorganic acids. The magnetic behaviour of cadmium salts has been compared with the behaviour of those of its family elements, Mg^{++}, Zn^{++}, & Hg^{++}. It has been found that the graphs of the molar susceptibilities of the salts of Mg, Zn, Cd & Hg against the number of electrons in the molecule are strikingly similar in nature. A linear relation has been obtained by plotting graphs between the molar susceptibilities of salts of Mg, Zn, Cd & Hg containing the same anion, and the number of electrons in the cations Mg^{++}, Zn^{++}, Cd^{++} & Hg^{++}. This linear relation has been employed to deduce the ionic susceptibility of Cd^{++} ion in inorganic and organic salts. The ionic radius of Cd^{++} has been calculated from the magnetic data and compared with the values given in the literature.

3. The Diamagnetic susceptibilities of Silver Salts.

MATA PRASAD, S.S. DHARMATTI *and* M. G. DATAR, Bombay.

Some silver salts of organic and inorganic acids have been prepared in a chemically pure state and their magnetic susceptibilities have been measured. The experimental value of the ionic susceptibility of silver has been determined from the mass susceptibilities of those compounds by the usual statistical method. A comparison of this value with the theoretical values calculated according to Slater's and Angus' methods shows that the experimental value is lower than the theoretical values. The experimental value of the ionic susceptibility of silver derived from organic salts is higher than the one derived from inorganic salts. The magnetic behaviour of some of the silver salts has been examined along with that of cuprous salts. It has been found that the graphs of mass susceptibilities against the total number of electrons in the compounds of silver and cuprous salts are strikingly similar in nature. The ionic radius of silver has been calculated from the magnetic data and is found to be slightly greater than the one obtained by Goldschmidt by X-ray method.

4. Ferroelectric Solids, KH_2PO_4, AmH_2PO_4, KH_2AsO_4 and AmH_2AsO_4.

S. K. K. JATKAR *and* S. N. GOPALASWAMY, Bangalore.

The existence of dielectric properties analogous to the magnetic properties of ferromagnetics has been observed in the case of the following substances, KH_2PO_4, AmH_2PO_4, KH_2AsO_4 and AmH_2AsO_4. It has been found necessary to postulate a critical temperature θ in order to satisfactorily account for the temperature coefficient of the dielectric constants of this class of substances. With the introduction of this characteristic temperature θ, the new equation relating dielectric constants (ε) and dipole moment (μ) becomes, $(\varepsilon - n^2)\frac{}{d} = \frac{4\pi N\mu^2}{K(T-\theta)}$. From the measurements on the dielectric constants the crystals KH_2PO_4, KH_2AsO_4, AmH_2PO_4 and AmH_2AsO_4 are found to have the transation temperature 115°K, 91°K, 155°K and 220°K respectively. These molecules have a moment of 2.04, 2.03, 2.77 and 2.74 respectively, ammonium ion influencing the moment.

5. The Dielectric Properties of the Complexes of the Halides of Aluminium, Boron and Beryllium.

S. K. K. JATKAR *and* S. N. GOPALASWAMY, Bangalore.

The molar polarization of the halides of aluminium, boron and beryllium has been calculated from the data for their complexes regarding them as forming ternary mixtures and accordingly the new equation was modified :

$$P_{123} = (\varepsilon - 1)\frac{M_1 f_1 + M_2 f_2 + M_3 f_3}{d_{123}} = P_1 f_1 + P_2 f_2 + P_3 f_3$$

The moments calculated for these halides in binary systems have been explained on the basis of the component law assuming that the bonds are free to rotate whereas in the case of ternary systems the organic componeats of the complexes hinder the

free rotation making the halide molecule rigid and the classical vector law holds good. The ionic characters of the bonds have been deduced from the observed and theoretical bond moments.

6. Dielectric Constant of the Oxides BeO, AS_2O_3, Sb_2O_3 & Bi_2O_3.

S. K. K. JATKAR *and* S. N. GOPALASWAMY, Bangalore.

Beryllium oxide has a dielectric constant of 12.55 at 30°C. as determined by the mixture method. From the data on the index of refraction and density the moment of the molecule is calculated to be 0.66. The effective moment of the Be-O bond is equal to the product of the observed moment and the coordination number. Accordingly the Be-O bond is 33% ionic which is exactly equal to the value $\left(\frac{Z_A}{Z_A+Z_B}\right)$. The dielectric constant of arsenious oxide has been determined by both the mixture method and the temperature method over a range of temperature from 30° to 70°. The oxide has a moment of 0.92. The effective As-O moment is four times this value, 4 being the effective coordination number. Accordingly the As-O bond is about 38% ionic. The values calculated by the new relationship for As-O, Sb-O and Bi-O are respectively 40%, 86% and 91% which are in fair agreement with the experimental values.

7. Dipole Moment of Alkyl and Phenyl Lead Halides.

S. K. K. JATKAR *and* R. J. SUJIR, Bangalore.

The new equation has been used to calculate the dipole moments of Triphenyl lead, Trimethyl lead chloride, Thiethyl lead chloride, Diethyl lead dichloride, Triethyl lead bromide, Triphenyl lead chloride, Triphenyl lead bromide and Triphenyl lead iodide. The ionic natures of Pb-Cl, Pb-Br and Pb-I have been calculated and compared with those obtained by the new relationship $\frac{Z_a}{Z_a+Z_b}$. The ionic characters calculated by Lewis *et al* are found to be systematically higher than those calculated by the new equation.

8. Dipole Moments of Certain Compounds of Sulphur, Selenium and Oxygen

S. K. K. JATKAR *and* R. J. SUJIR, Bangalore.

The new relationship has been used to calculate the dipole moments of hydrogen disulphide, sulphur mono-chloride, selenium monochloride, selenium oxychloride and thiophosphoryl chloride. The moments calculated by the new equation are independent of concentration unlike the D.C.M. equation. The ionic characters are calculated and checked with theoretical values.

9. On the Volumetric Estimation of Cerium by $KMnO_4$.

G. S. DESHMUKH, Banaras.

The present work arose out of the difficulties experienced in the detection and separation of cerium from zirconium and thorium in the qualitative analysis of mixtures containing other common inorganic radicles. The separation of these rare earths from other radicles of the third and subsequent groups is affected by their coprecipitation as oxalates in acidic solutions. Further analysis of the combined oxalates depends on the solubility of thorium and zirconium oxalate in ammonium oxalate solution. Resuts of a series of experiments have shown that cerium oxalate is also partially soluble in ammonium oxalate and therefore, the detection and estimation of cerium is unsatisfactory. A simple process for estimating cerium volumetrically by $KMnO_4$ has been developed by modifying the classical oxalate method used generally to determine cerium gravimetrically as CeO_2. Data are given to show that the results are within the limits of experimental error.

10. Application of the Solubility Method for the Elucidation of the Compositions of some Complex Compounds of Silver—Part I. Study of $AgCl$-$Na_2S_2O_3$ system.

ARUN K. DEY *and* A. K. BHATTACHARYA, Saugor.

The solubility method of Dey (*Compt. Rend. Acad. Sci.*, U.S.S.R., 1947; *J. Ind. Chem. Soc.*, 1947; *Proc. Ind. Sci. Cong.*, 1948) has now been applied for the study of complex formation between silver chloride and sodium thiosulphate. The formation of the complex argentothiosulphate may be represented to proceed according to the following equation:

$$nAg^{\circ} + S_2O_3'' \longleftrightarrow [Ag_nS_2O_3]^{(2-n)}$$

The value of n in this case works out to be:

$$\frac{-\left\{\log\frac{a_1}{a_2} - \log\frac{c_1}{c_2}\right\} \pm \sqrt{\left\{\log\frac{a_1}{a_2} - \log\frac{c_1}{c_2}\right\}^2 - 4\log\frac{a_1}{a_2}\left(\frac{a_1}{c_1} - \frac{a_2}{c_2}\right)}}{2\log(a_1/a_2)}$$

when a_1 and a_2 represent the quantities of silver dissolved in c_1 and c_2 concentrations of thiosulphate solutions respectively, the method of calculations being similar to those described in previous publications.

The solubilities of silver chloride in varying concentrations of sodium thiosulphate solutions have been determined at different temperatures. On calculating the values of n with the help of the expression derived, it is found that the values of n at 15°C varies from about 0.65 to 0.84 with increase in the concentration of thiosulphate. Similarly at 30° n varies from 0.55 to 0.95, while at 40° it does not change so remarkably, remaining almost equal to 0.5 with all the concentrations of sodium thiosulphate used.

It has therefore been concluded that the complex ions have the formulae $[AgS_2O_3]'$ and $[Ag(S_2O_3)_2]'''$ and the variations in the values of n correspond to the compositions of mixtures of the monovalent and trivalent complexes, the ratio of which is regulated by the conditions of temperature and concentration.

11. Application of the Solubility Method for the Elucidation of the Compositions of some Complex Compounds of Silver—Part II. Study of $AgBr$-$Na_2S_2O_3$ system.

ARUN K. DEY, Saugor.

In continuation with the work on complex argentothiosulphates, the composition of the complex ions formed by the interaction between silver bromide and sodium thiosulphate has been calculated with the help of the expression derived in Part I of the present series of papers.

In this case the vaues of n also change with the change in concentration of thiosulphate and also with temperature. An examination of the experimental results shows that at 30° the value of n changes from 0.37 to 0.51, at 50° from 0.53 to 0.67 and at 75° from 0.74 to 0.94. A perusal of the values of n in this case too suggests the existence of mono- and trivalent complex ions of the compositions $[AgS_2O_3]'$ and $[Ag(S_2O_3)_2]'''$. It is interesting to observe that with rise in temperature the chances of the formation of the trivalent complex ion are more prominent in this case.

12. Application of the Solubility Method for the Elucidation of the Compositions of some Complex Compounds of Silver—Part III. Study of Ag_3Cit-Na_3Cit system.

ARUN K. DEY *and* A. K. BHATTACHARYA, Saugor.

During the study of the preparation of some silver hydrosols of silver by the reaction of silver citrate, Ghosh and Chakravarti (Doctoral Thesis, Allahabad, 1945) observed that in the presence of citric acid the solubility of silver citrate was markedly

enhanced. They have ascribed this phenomenon to be due to the excess of hydrogen ions in the solution contributed by citric acid. This work has now been extended and we observed that augmented solubility is also observed on using a solution of sodium citrate. Thus, this is evidently a case of complex formation, which view has been further substantiated by actual solubility determinations and utilisation of the data for the calculation of the composition of the comlex ion by a method similar to that described by us in Parts I and II of the present series. (Cf. also Dey, *Compt. Rend. Acad. Sci.*, U.S.S.R.,1947, *J. Ind. Chem. Soc.*, 1947; *Proc. Ind. Sci. Cong.*, 1948).

The complex formation may be represented by the equation :

$$n\mathrm{Ag_3Cit} + \mathrm{Na_3Cit} \leftarrow\rightarrow \mathrm{Na_3[Ag_{3n}(Cit)_{n+1}]}$$

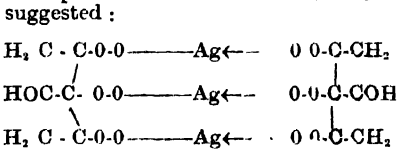
In this case the value of n when calculated is found to be:

$$\log \frac{s - 3\sqrt{k/c}}{s' - 3\sqrt{k/c'}} - \log c/c'$$

$$\frac{1}{3}\log\left[k\left(\frac{1}{c} - \frac{1}{c'}\right)\right] + \frac{1}{s' - 3\sqrt{k/c'}} - \frac{1}{3\sqrt{k/c}}$$

where k is the solubility product constant of silver citrate, and s and s' the solubilities of Ag in sodium citrate solutions of concentrations c and c' respectively.

The experiments were conducted at 30°C, and the values of n worked out to be almost equal to unity in all the cases, with different concentrations of sodium citrate. Thus the complex compound has the formula: Na_3Cit, Ag_3Cit and the following structure has been suggested :



13. Studies on the formation of complex compounds between Alkaline Earth Nitrates and Alkali Nitrates. -Part I. System: $Ba(NO_3)_2$-KNO_3-H_2O.

M. R. NAYAR *and* P. A CHAUHAN, Lucknow.

A double salt of the formula $Ba(NO_3)_2 . 2KNO_3$ has been long known to exist, but somewhat inexplicable results obtained by Fundlay and coworkers (*Journ. Chem. Soc.* 1914, 779.) necessitate detailed systematic investigation of the system $Ba(NO_3)_2$—KNO_3—H_2O. Conductivity of solutions containing varying amounts of barium nitrate (ranging from M/60 to M/3) mixed with constant concentration of potassium nitrate was measured. A sharp kink in the graph was obtained at a point corresponding to the formation of the compound $Ba(NO_3)_2 . 2KNO_3$. This abnormality in the graph can only be explained by assuming that there exists some complex ion besides simple Ba^{++}, K^+ and NO_3^- ions at that concentration. Further work on the subject is in progress.

14. Studies on the formation of complex compounds between nitrates of Zinc group and Alkali nitrates.—Part I. System : $Zn(NO_3)_2$-KNO_3-H_2O.

M. R. NAYAR *and* P. R. CHAUHAN, Lucknow.

Literature gives no information whatsoever on the formation or otherwise, of the complex compounds between zinc nitrate and potassium nitrate, though complexes between chlorides, bromides, sulphates, nitrites and even citrates and tartarates of the two metals have been described. The application of various physico- chemical properties with a view to find out complex ion formation as followed by Nayar and Pande (*Proc. Ind. Acad. Sci.*, 1948, April and May issues) in the case of lead nitrate and alkali nitrates was extended to zinc nitrate and potassium nitrate in aqueous solutions. The properties chosen for investigation were Viscosity and Conductivity, each depending

on factors entirely different from one another, the former being a bulk property and the latter being affected by ions. When values for viscosity and conductivity were plotted against varying concentrations of zinc nitrate (concentration of potassium nitrate being kept constant at M/3), it was found that both the curves thus obtained were smooth without any abnormality, indicating that the tendency for complex formation which is so marked in the case of lead nitrate and potassium nitrate (Nayar and Pande, *loc.cit*), disappears when zinc nitrate is substituted for lead nitrate in the system.

15. Studies on the formation of complex compounds between Nitrates of Zinc group and Alkali Nitrates.—Part II. System: $Hg(NO_3)_2$-KNO_3-H_2O.

M. R. NAYAR *and* P. R. CHAUHAN, Lucknow.

The system: mercuric nitrate - potassium nitrate - water, was next investigated. Viscosity and conductivity were measured as in the case of zinc nitrate and potassium nitrate. The values obtained were plotted against varying concentrations of mercuric nitrate (ranging from M/60 to M/2) - concentration of potassium nitrate being kept constant at M/3. The curves thus obtained were regular without abnormalities, showing that solutions in all ratios of the two salts behave as simple mixtures of mercuric nitrate and potassium nitrate and that there is no tendency for complex formation. Ephraim (*Inorg. Chem.* 1943, 699.) has postulated mercury acting as a central atom to co-ordinate with several nitrate groups, but our work has not given the anticipated results at the concentrations chosen.

Since zinc nitrate and mercuric nitrate yielded similar negative results it was considered unnecessary to investigate the intermediate salt cadmium nitrate.

16. Formation of Complex compounds between Lead Nitrate and Alkali Nitrates.—Part VII. The system: $LiNO_3$-$Pb(NO_3)_2$-H_2O

M. R. NAYAR *and* C. S. PANDE, Lucknow.

In previous communications (*Proc. Ind. Acad. Sci.*, A, 1948, *27*, 284-299 & subsequent issues), it has been shown that three definite complexes are produced in solution in each of the systems: KNO_3-$Pb(NO_3)_2$-H_2O & NH_4NO_3-$Pb(NO_3)_2$-H_2O, while no such formation could be detected in the sustem: $NaNO_3$—$Pb(NO_3)_2$—H_2O. It was of interest to extend the investigations to other alkali nitrates above sodium and below potassium. This paper reports the results obtained with the system: $LiNO_3$—Pb $(NO_3)_2$—H_2O. The properties investigated were viscosity, conductivity and transport number. The methods employed were the same as described before.

When the values of viscosity and conductivity were plotted against the concentration of lead nitrate, smooth curves were obtained without any kinks. All the plots were regular indicating the tendency for the formation of complex compounds to be nil. Transport number values also showed no marked change, leading to the same conclusion.

Thus lithium nitrate like $NaNO_3$ and unlike KNO_3 and NH_4NO_3 has no tendency for the formation of complex compounds with lead nitrate. This was expected from its position in the Periodic Table.

17a. Formation of complex compounds between Lead Nitrate and Alkali Nitrates.—Part VIII (pH measurement).

M. R. NAYAR *and* C. S. PANDE, Lucknow.

In continuation of our investigations described in the preceding parts of this series (*Proc. Ind. Acad. Sci.*, A, 1948, April & May issues), we report our results in this paper on pH measurements by using glass electrode. For pH measuremenrs the glass electrode assembly used was the one described by Nayar & Srivastava (*Curr. Sci.*, April 1947, *16*, 116). The potentiometer was calibrated in the usual way by using standard Weston cadmium cell.

Buffer solutions were prepared having pH values between 2-9 and corresponding E.M.Fs measured. Thus a standard graph (a straight line) was obtained, connecting the pH with E.M.F. The pH of any unknown solution could be read from the graph, if the E.M.F. was known.

The results obtained with the various solutions prepared as described in the earlier parts of this series were represented graphically, *i.e.* pH values plotted against the concentration of lead nitrate. These graphs indicate that there is no complex formation in the system : $LiNO_3-Pb(NO_3)_2-H_2O$, while three definite complexes are present in solution in the systems: $KNO_3-Pb(NO_3)_2-H_2O$ & $NH_4NO_3-Pb(NO_3)_2-H_2O$. The molecular formulae of these compounds are, $4RNO_3.Pb(NO_3)_2$, $2RNO_3.Pb(NO_3)_2$ & $RNO_3.Pb(NO_3)_2$ (where R stands for K or NH_4). Thus the results obtained with pH measurements are exactly in conformity with observations and results obtained from other physico-chemical properties.

17b. Formation of complex Compounds between Lead Nitrate and Alkali Nitrates.—Part IX. The system : $Rb(NO_3)_2$-$Pb(NO_3)_2$-H_2O.

M. R. Nayar *and* C. S. Pande, Lucknow.

In the previous parts of this series we have already shown the existence of three complex compounds in solution in each of the systems : $KNO_3-Pb(NO_3)_2-H_2O$ & $NH_4NO_3-Pb(NO_3)_2-H_2O$, while no such formation was observed in the systems: $LiNO_3-Pb(NO_3)_2-H_2O$ & $NaNO_3-Pb(NO_3)_2-H_2O$. It was of interest to extend the investigations to other alkali nitrates above potassium. In this paper we report our results obtained with the system: $RbNO_3-Pb(NO_3)_2-H_2O$. The properties investigated were viscosity, conductivity and transport number. This system has not been investigated before by any other previous workers.

Physical Chemistry

18. Magnetic Study of Some Hydrates.

Mata Prasad, S. S. Dharamatti, C. R. Kanekar, *and* N. S. Biradar, Bombay.

Magnetic susceptibilities of a number of hydrates have been measured along with the susceptibilities of their corresponding anhydrous salts, in the solid state, and have been compared with those calculated for these hydrates on the strict additivity basis. The results show that the percentage deviation of the observed values from calculated specific susceptibilities of these hydrates bears no generalised relation of any nature with the total heat of hydration. The percentage deviation per molecule of water of crystallisation has been found to become less and less as the heat of hydration per molecule increases.

The deviation in the molecular susceptibility from additivity rule is greatest in the hydrate containing the least number of molecules of crystallisation, and tends to decrease as the number of molecule of water of crystallisations increases. The heat of hydration per molecule of water of crystallisation increases in the same order as the deviation in x_M per molecule. The departure from the additivity rule has been explained on the basis of bindings between the molecules of water of crystallisation and the anhydrous salts.

Susceptibilities of some hydrated and anhydrous substances have also been deduced from the susceptibilities values of their aqueous solutions. A comparison of the values of the susceptibilities of hydrated obtained from solutions with those of anhydrous salts also from solutions shows that (i) the diamagnetism due to water of crystallisation is not strictly additive in solutions and (ii) the effect of hydration of ions is greater in the case of solutions of the anhydrous salts than that in the solutions of the hydrates.

19. Magnetic Study of Some Alkali Salts of Organic Acids.

Mata Prasad, S. S. Dharmatti *and* D. D. Khanolkar, Bombay.

A large number of salts of lithium, sodium and potassium with organic acids have been prepared in a chemically pure state and their susceptibilities have been measured by a modified form of Gouy's balance. A linear relation has been found to exist between the molecular susceptibility and the number of electrons in the cation in the case of the alkali salts having the same anion. This relation has been used to determine

the susceptibilities of a large number of anions in combination with lithium, sodium and potassium ions. These anion values have been further employed to calculate the ionic susceptibilities of lithium, sodium and potassium. The value of the susceptibility of the CH_2 group has been determined for the homologous series consisting of formate, acetate, propionate, butyrate, palmitate and stearate of lithium, sodium and potassium. The results have been examined in general in the light of conclusions arrived at from the study of salts of organic and inorganic acids of metals of the second group of the periodic table made by Prasad and co-workers.

20. The Heat of Combustion of Resonating Molecules.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

The heat of combustion of aromatic molecules agrees with the value calculated on the basis of equal resonance between Kekule and Claus (centric) structures. The binding energy of the para linkages in the latter was calculated on basis of inverse proportionally between the energy of a bond and the internuclear distance. The following table gives the results.

Energy of benzene and substituted compounds.

Compound	Kekule	Centric	mean	observed
Benzene	828	743	785.5	788
Diphenyl	1601	1533	1517.0	1510
Styrene	1104	1025	1064.0	1054
Pyridine	712.8	632	672.0	669
Indole	1064.0	954	1026.0	1035
Toluene	986.0	901	944.0	945
Aniline	871.0	784	828.0	820
Phenol	795.0	709	752.0	745
Naphthalene	1325.0	1158	1242.0	1248
Anthracene	1822.0	1573	1698.0	1706
Quinoline	1209.0	1050.6	1128.8	1123

21. Molecular Refraction.

S. K. K. JATKAR, R. J. SUJIR *and* B. R. Y. IYENGAR, Bangalore.

The new equation for molecular refraction has been applied to interpret quantitatively the variation of refractive index of binary mixtures of chlorobenzene, isopropylalcohol, nitrobenzene and benzene in cyclohexane, hexane, carbontetrachloride, and benzene with varying concentration.

The molecular refractions of i-propylalcohol, benzene and chlorobenzene in hexane and chlorobenzene in carbontetrachloride and benzene, and i-propylalcohol in benzene do not vary with concentration showing the validity of the new expression for molecular refraction. In the case of chlorobenzene in cyclohexane the molecular refraction shows a little variation in the dilute regions and in the case of nitrobenzene and benzyl alcohol in benzene the molar refraction increases with concentration.

In all cases it has been observed that the anomalous variation of molar refraction is mostly in dilute regions indicating that the solvent molecules are responsible for complex formations.

22. Electric Moment of Silica.

S. K. K. JATKAR *and* B. R. Y. IYENGAR, *Bangalore*.

The electric moment of silica calculated by the new equation $(\varepsilon-n^2)\frac{M}{d}=\frac{4\pi N\mu^2}{k(T-\theta)}$ (where 'θ' the critical temperature is 575°C $\alpha-\beta$ quartz inversion temperature) is 1.0D. Considering SiO_2 moment as a vector of two mutually tetrahedrally inclined Si-O bonds the moment (observed) of Si-O bond is 0.86D. The true moment of a 'free' Si-O bond is 0.86×2 (co-ordination number) 1.72D agreeing with the calculated value $e\times d\times \frac{Zsi}{Zsi+Zo}\times n$ where Z's are atomic numbers and $n=1/3$. At low temperatures ($\theta-O$) the observed Si-O moment is 0.43D so that the true moment of the free Si-O bond is again 1.72D (0.43×4, the co-ordination number).

23. Apparent Molal Volume of Sodium Chloride in Aqueous Solution.

BALBHADRA PRASAD *and* SHYAMASUNDER PANDA.

The apparent Molal Volume (ϕ) of electrolytes should be represented by an equation of the type $\phi=\phi_0+a\sqrt{c}+bc$ where 'a' is the same for all electrolytes of the same valence type. There has been a good deal of difference in the results obtained with different salts of the same valency type. To see whether the differences are due to experimental error or are real, density measurements have been made to an accuracy of two in a million with the help of two pyknometers of the same size, one containing the solution and the other containing the solvent at the same temperature. The theoretical value of 'a' is very nearly equal to the experimental value.

24. Influence of Temperature on *Joshi-Effect* in Iodine Vapour.

M. V. RAMANAMURTI, Banaras.

Studies of *Joshi-effect*, Δi were made in iodine vapour, in contact with the solid phase, at different temperatures, t in the rango 20 to 60°C, over a potential range 200-1100 volts (rms), with A.C. indicator, diode 83V (RCA).

At a constant potential V, the discharge current, i increases markedly with t. Thus *e.g.*, at $t=20$ and 60°C, i_0 in dark at 730 V, was respectively 642 and 1220. 'Threshold potential' V_m, increases with t from 320 at 20°C to 340 at 60°C.

Δi is +ve at low and -ve at large V. The transition $+\Delta i\rightarrow-\Delta i$ occurs at a critical '*inversion potential*', V_c near V_m, and, in agreement with the general finding of Joshi (*Curr. Sci.*, 1947, *16*, 19), is potential reversible.

At fixed V, $+\Delta i$ and $+\%\Delta i$ increase with t while $-\Delta i$ and $-\%\Delta i$ decrease. Thus *e.g.*, at 315V, $+\Delta i$ and $+\%\Delta i$, 44 and 64 respectively at 20°C increased to 64 and 1600 correspondingly at 60°C. At 420V, $-\Delta i$ and $-\%\Delta i$, -300 and -53 at 30°C decreased numerically to -30 and -8 at 60°C respectively. Occurrence of $+\Delta i$ according to Joshi (*loc. cit.*) is due to a great porbability for photo-ionisation of the pre-excited molecules. Increase of t enhances pre-excitation, whence increased $+\Delta i$. Decrease with t of $-\Delta i$ is due to the deconditioning influence of t on the 'activated layer' postulated by Joshi (*Phy. Sec.* A *26*, 1946; *Curr. Sci.*, 1946, *15*, 281) for the occurrence of $-\Delta i$.

At a fixed V, near V_m, $-\Delta i\rightarrow+\Delta i$ occurs *progressively* with t, with the change of sign at an '*inversion temperature*' t_c. Thus *e.g.*, at 340 V, Δi is -102 (20°C), -54 (30°C), $+48$(40°C), $+66$(50°C) and $+210$(55°C). t_c is higher for larger V; *e.g.* t_c for 340 V is 35°C and 400V; 55°C. These results indicate *simultaneous* occurrence of $+\Delta i$ and $-\Delta i$; the larger in magnitude governing the sign of the net *effect*.

25. Influence of Frequency of Exciting Potential on the *Joshi-Effect* in Oxygen.

S. R. MOHANTY, Banaras.

The influence of the frequency f of the exciting potential on the *Joshi-Effect* Δi in oxygen enclosed in a Siemens' tube at 331 mm pressure 32°C has been investigated.

In agreement with Joshi's general findings (*Proc. Ind. Acad.*, 1945, A *22*, 389; *Curr. Sci.*, 1946, *15*, 281) Δi and the 'threshold potential' V_m decrease with *f*. Thus, at a constant current in dark iD=3, the relative *effect* $\%\Delta i$ was 42 at 50~ and diminished to 21 at 500~. V_m at the above values of *f* was respectively 2.7 and 0.7 *k*V (r.m.s.). When the ozoniser was fed with high frequency (3-11 megacycles) currents generated by a modified Hartely type oscillator, Δi was absent despite large currents obtained.

According to Parshad (*Nature*, 1944, *155*, 362), Δi represents a diminution of the displacement as distinct from the conduction or ohmic current. Proportion of the former increases with *f*. The variation with *f* of Δi is opposite. This and the non-occurrence of Δi under high frequency potentials when the condition is mainly dielectric do not support Parshad's view.

26. Studies of Joshi Effect in Aerial Currents.

N. ATCHUTA RAMAIAH *and* M. V. RAMANAMURTI, Banaras.

That an ozonizer-like vessel, when excited, behaves like a transmitter especially markedly under optimum conditions for *Joshi-effect*, Δi was emphasised by Joshi (B.H.U. *Journ.*, 1943,*8*, 103; *Nature*, 1944, 154, 147). Studies of Δi were made in the currents *i* picked up by an aerial when two Siemens Ozonizers A and B containing iodine vapour were excited separately (A—and B—) and simultaneously (AB—) by A.C. potentials V, of 50 cycles frequency over 0—2 *k*V.

At a fixed V, *i* and Δi under simultaneous excitation are additive of the corresponding quantities when excited individually. Thus, *e.g.*, under A—, B— and AB— excitations, i_D under dark is 17, 11 and 27 at 0.53*k*V and 80, 53 and 132 at 2.1*k*V respectively; while corresponding values for Δi are 12, 8 and 19 at 0.53 *k*V and 37, 27 and 57 at 2.1 *k*V respectively. $\%\ \Delta i$, however, does not follow this, for obvious reasons.

27. Periodic Reversal in Conductivity and of the *Joshi-Effect* in Iodine Vapour.

G. S. DESHMUKH, Banaras.

Earlier results reported occurrence of 'ageing' *i.e.*, a time variation in the conductivity *i* of bromine vapour excited under silent discharge at a constant applied potential V. Extension of these results to iodine vapour suggested by the non-identical rising and falling V-*i* characteristics observed during studies of the *Joshi-Effect* Δi in the above system revealed a spontaneous self reversal in the conductivity *i* under constant exciting conditions. The associated *Joshi-Effect* Δi, in iodine vapour 'aged' under the discharge at a constant applied V also showed a synchronous time variation in its magnitude. This reversal in *i* and Δi, is more pronounced at high temperatures and especially when the system is 'preheated' at a given temperature for about 300 minutes. The conductivity decreases during the 'rest period' *i.e.*, the interval between two successive exposures to discharge. Prolonged 'ageing' stabilizes *i*, the corresponding Δi, is, however, reduced appreciably (progressively).

28. Comparative Study of the Conductivity and the *Joshi-Effect* in Heterogeneous and Homogeneous Discharge in Iodine Vapour.

G. S. DESHMUKH *and* P. K. SHARMA, Banaras.

The non-identity of the rising and falling V-*i* characteristics indicative of hysteresis was observed during studies of the *Joshi-Effect* Δi in excited bromine and iodine. In iodine vapour hysteresis was comparatively more pronounced in presence of an annular coat of iodine than that observed in a homogeneous vapour phase. The influence of the presence of powdered iodine on the occurrence and the magnitude of hysteresis in iodine vapour excited under silent discharge has now been studied in some detail.

The exciting potential was increased progressively from 1.2 to 1.9 *k*V of 50 cycles frequency and was reversed to the initial minimum *viz.*, 1.2 *k*V; this being the 'threshold potential' V_m of the system. The current *i* was measured with a reflection galvanometer actuated by a 83V double diode. Two series of experiments were carried out. In the first series the total (secondary) current was passed through the detector. In the other set the N.F. oscillations were damped by introducing a high resistance in the L.T. circuit. This stabilised the conductivity *i* but reduced the magnitude of hysteresis and Δi appreciably. For example, at 1.2*k*V, by eliminating the H.F. compo-

hents, the % increase in i_D and i_L due to hysteresis was reduced from 100 and60 to 8 and 5.2 (*i.e.* by about 90%) respectively; the corresponding decrease in Δi and $\% \Delta i$ was about 80 and 70 percent respectively. This indicates that hysteresis orginates in the H. F. components which, according to Joshi's theory, are also the chief seat of i. Results obtained during a series of potential reversals show that i is greater for the falling applied V than that observed during its progressive increase. The percentage increase in the conductivity is, however, greater for i_D than for i_L and is maximum near V_m. Previous results have shown that the relative *Joshi-Effect* $\% \Delta i$ reaches prolonged 'ageing'and its increase due to packing of the discharge space with powdered iodine suggests its remarkable correspondence with Δi.

29. On the '*Sintering*' of the Surface Film as a Determinant of the Conductivity Under Discharge and of the *Joshi-Effect*.

G. S. DESHMUKH, Banaras.

The marked dependance of the magnitude and even sign of the *Joshi-effect* Δi on the nature of the adsorption like electrode layer has been emphasised by Joshi. The influence of the applied potential V, temperature, the gas pressure p and the duration of 'ageing' on the behaviour of the boundary layer has been studied in some detail in case of halogens. The present work reports observations on the time hysteresis in the conductivity of excited bromine and iodine and the influence of ' rest period ' of different durations on the variation of i stabilised under prolonged 'ageing'. In the case of bromine the conductivity increases with the duration of the ' rest period'; in iodine vapour, however, the current decreases by about 10-20% when the ' rest period ' is varied from 30 to 720 minutes. This has been attributed to the marked difference in the behaviour of the adsorption layer of NaBr and NaI formed as a result of the interaction under the discharge of the excited vapour and the glass walls of the discharge tube. It is known that a film of sodium bromide sinters gradually even at room temperature. The adsorption of iodine on the surface of NaBr abrogates the effect of sintering. This suggests that the surface film of NaI should be comparatively more stable than that of NaBr. It is suggested that the increase in the % restoration of i with the duration of the 'rest period' observed in the case of excited bromine is due to the gradual sintering of the adsorption layer of sodium bromide. The decrease of i observed in excited iodine vapour after each successive ' rest period ' may result from an increase in Cw, the total wall capacity of the system due to the greater stability of the adsorption layer of iodine or/and NaI and the increased rate of adsorption of iodine during the ' rest period.'

30. The Disparity in the Times for Current Suppression and Restoration in the Production of the *Joshi-Effect* : Influence of Intensity of Irradiation.

H. J. ARNIKAR *and* N. GOPALASWAMI, Banaras.

The finding of Prof. Joshi (unpublished results) that the time (T_R) for the restoration of i_L, the current under irradiation to i_D, the original value in dark, is sensibly greater than the time (T_S) for the photosuppression of the current, $-\Delta i$, has been the subject of general investigation in these laboratories. In the present work, the ratio T_R/T_S has been measured in bromine under conditions of constant voltage and frequency of A.C. supply, and various light intensities measured thermopilically. A 600-fold variation of intensity showed that the ratio T_R/T_S falls from 1.45 to 1.08. (4.95 *kV* and 500 cycles frequency). It is significant to note that this ratio tends to limiting values on both the high and low intensity sides, corresponding but not exactly coinciding with the changes in the *Joshi-effect* : whilst relatively, the *Joshi-effect* reaches saturation of about 40% at intensities > 400, the ratio T_R/T_S continues to rise to a stationary value of 1.45 (by extrapolation). Precisely similar observations were made in the case of the exciting field of 2.31 *kV* and 50 cycles frequency.

The study of the ratio T_R/T_S under varying intensities of irradiation have confirmed the general finding of a close parallelism between this ratio and the magnitude of the *Joshi-effect*, which is consistent with Prof. Joshi's theory that photoelectric emission from the boundary layer formed in part by an adsorption of ions and excited molecules (produced under the discharge) is the primary factor in the occurrence of this effect.

31. The Occurrence of Hysteresis in the *Joshi-Effect.*

N. GOPALSWAMI *and* K. S. VISVANATHAN, Banaras.

The phenomenon of hysteresis has been studied in Cl_2, I_2, and *air* (the last taken at a very low pressure) excited by alternating potentials of frequency 50 and 500 cycles per second, using a semi-ozoniser for Cl_2 and Siemens' ozoniser for I_2 and air. The applied potential was varied in the range, 1.88-4.30 *kV* for Cl_2, 0.37-0.51 *kV* for I_2 and 0.65-2.7 *kV* for air; first it was raised gradually to the maximum value of the range studied and then lowered to the initial value. The corresponding values of the current i_D and i_L observed when the ozoniser was (i) in dark (ii) irradiated by a 200-watt bulb, were measured by means of a reflection galvanometer after rectification of the current by a diode. Cl_2 was taken at 200 mm., I_2 at its vapour pressure at room temperature, which was between 1-2 mm; in the third case, the ozoniser contained only '*residual*' air after evacuation by the Topler. In the case of air, the effect of KCl was studied (i) by keeping it in a bulb connected to the annular space, and (ii) after inverting the ozoniser and thus filling the annular space with powdered KCl.

Both i_D-V and i_L-V characteristics show hysteresis but not to the same extent. Hence, the net *Joshi-Effect* Δi (*i.e.* i_L-i_D) as well as % Δi ($= \frac{\Delta i}{i_D} \times 100$) shows hysteresis. The *Joshi-Effect* at a particular applied potential is larger when V is diminishing than when increasing. Even when the *Effect* is compared at a difinite value of i, obtained once when V is being raised and again when V is being lowered, hysteresis is obtained. While hysteresis in the case of i_D-V is known, it is remarkable to observe such a phenomenon in i_L-V and especially in $\Delta i - V$ and Δi-i_D curves. Since, according to Joshi, the *Effect* is of surface origin and occurs chiefly in the High Frequency part of the discharge current, it would follow that the 'active electrode lyer' postulated by Joshi, as a function of the applied potential is not entirely potential reversible but that there is a lag between the two. It also follows that the proportion of H.F. in i_D remains greater when the potential is diminishing than when increasing.

While the *Effect* is obtained in '*residual*' air, and shows hysteresis, it is completely absent when the annular space is filled with KCl powder.

32. Inhibition of the *Joshi-Effect* in Br_2 due to Admixture with H_2.

K. S VISVANATHAN, Banaras.

Detailed work in Br_2, a strongly electro-negative gas, subjected to ozoniser excitation has revealed the occurrence of both positive *Joshi-effect*, which is remarkable, as well as the expected negative *Effect*. As first observed by Joshi, the positive *Effect* is comparatively restricted to a narrow range of low exciting potentials near/below V_m. Increasing the 'electron affinity' of the medium by admixing with it gases possessing high electron affinity such as chlorine enhance the negative *Effect* to as much as even 100%. Hydrogen taken alone gives the positive *Effect* only. As is to be expected from the poor electron affinity of hydrogen, admixing it with Br_2 reduces the magnitude of the negative *Effect* in Br_2. Increasing the proportion of H_2 in the mixture is followed by an enhancement of the positive *Effect* and a diminution of the negative *Effect* given at higher potentials. A still higher proportion of H_2 inhibits the negative *Effect* in Br_2 completely. These observations point to the importance of the electron affinity of the medium in relation to the production of the *Joshi-Effect*, which is in accord with Joshi's general theory of the phenomenon.

33. Comparative Time Variation of the *Positive* and *Negative Joshi-Effect*, produced in Chlorine and Iodine Vapour under 'Wall-influence.'

B. M. SHUKLA, Banaras.

The primary role of 'wall-influenced' discharge in enhancing the *Positive Joshi-effect* over a wide range of *kV*, away from V_m (Shukla, *Proc. Ind. Sci. Cong. Chem. Sec.* Abst. No. 19, 1947) facilitated to study the comparative influence of 'ageing' on $-\Delta i$ and $+\Delta i$. In chlorine the *positive Joshi-effect* distinctly decreased with time to a minimum, *e.g.*, at 9.6 *kV*, +16% Δi reduces to +5% Δi under 150 minutes discharge;

in Iodine + Δi, occurring only below V_m, changes sign. This time decrease of *Positive Joshi-effect* is akin to Photo-electric fatigue. However, *negative Joshi-effect* increases numerically, both in Δi, with 'ageing;' *e.g.*, for chlorine, at 8 *kV*, $-\%\Delta i$ increases from from 45 to 56 in 2½ hours discharge.

The above distinct and reverse role of 'ageing' on $-\Delta i$ and $+\Delta i$ is sought to be explained on Joshi's 'Boundary layer' postulate. 'Ageing' enhances the 'activated-layer' formation, thereby decreasing the work-function ϕ, leading to an increased electron emission and subsequent formation of heavy negative ions under light. $-\Delta i$ increases thus. The simultaneous occurrence of $\mp\Delta i$ in Chlorine, is shown as a result of study of aerial current and influence of R and capacitance C (Shukla, *ibid*, No. 37, 1948), hence the observed *Joshi-effect* is $\Sigma \mp \Delta i$. Increase in $-\Delta i$ with time, subsequently decreases $+\Delta i$. This time variation study indicates the advantage of the widely occurring *negative Joshi-effect*, over the common Photo-electric effect which suffers fatigue.

34. Role of Cu_2O Electrode in the Discharge Space, in the Study of the Joshi-Effect in Topler Vacuated Ozoniser.

B. M. Shukla, Banaras.

The known behaviour of Cu_2O electrode under light and the significant role of photo-electrons as a determinant of the *negative Joshi-effect* has led to the following investigation:

The ozoniser, having Töpler vacuum and two L.T. leads, one for the small Cu_2O electrode freely hanging in the discharge space, and the other covering the outer glass surface spirally, was excited between 0.5-1 *kV* by 50 cycles frequency. Vacuo-junction was used as detector throughout. Firstly, with the outer surface as L.T. electrode, no *Joshi-effect* was observed, possibly due to absence of a solid gas interface, its importance being emphasised by Joshi (*Curr. Sci.*, 1945, *14*, 175). Secondly, with the Cu_2O electrode as the L.T. one, $-55\%\Delta i$ was shown, rapidly decreasing with increasing V. The emmission of photo-electrons from this Cu_2O electrode accounts for the above negative *Joshi-effect*. Later, the ozoniser was 'aged' for 4 hours; and now the outer glass surface when used as L.T. electrode showed $-100\%\Delta i$. This finds explanation in the 'activated layer' formation due to the residual gas, the decomposition of Cu_2O under electrical discharge being not possible. After this, the Cu_2O electrode when used or the L.T., showed a +4% *Positive Joshi-effect*. This is probably due to an increased photo-electron emission from the 'activated glass layer' than from the small Cu_2O electrode itself. These photo-electrons from the glass surface reach the Cu_2O electrode and thus a $+\Delta i$ is obtained. The above study of the role of Cu_2O electrode is in conformity with the 'Activated layer postulate'.

35. Comparative Studies of *Joshi-Effect* in Chlorine and Air using metallic electrodes.

D. V. Ramana Rao, Cuttack.

The production of *Joshi-effect*, $\mp\Delta i$ in Geissler discharges has been reported (Ramana Rao, Abst., communicated *Phys. Sec. Indian Sci. Cong.*, 1949). The medium was chlorine enclosed at 100 mm. pressure. The present work refers chiefly fo discharges in air at a very low pressure.

Five discharge tubes were taken, differing only in the length of the tube. They were excited electrically by feeding in D.C. potentials obtained from a point-to-plate rectifier energised by a H.T. transformer. The current in the dark, i_D, and under light i_L were measured by a reflection galvanometer actuated by a diode 80V.

The potential variation of *Joshi-Effect* is more marked and abrupt in air than in chlorine. Whilst in the case of chlorine the effect Δi was observable over a wide potential range, it was detected over a very narrow range exciting potentials in air. Thus *e.g.*, in the former case, $-\%\Delta i$ was 76 at 2.16 *kV* and 7 at 2.7 *kV* and in the latter, it was 43 at 2.84 and nil at 2.97 *kV*.

Deo reported that in ozoniser discharges, the relative *Joshi-effect* $-\%\Delta i$ increases with 'ageing' under discharge (*Proc. Ind. Acad. Sci*, 1945, *21*, 76). In Geissler discharges, however, $\%\Delta i$ decreases with continuous 'ageing', becomes nil and changes sign also. This decrease is more marked in air than in chlorine; *e.g.*, $\%\Delta i$ at 9.3 *kV* was −13, −5 and +2 at the start, after 10 and 20 minutes 'ageing' respectively in the tubes containing air whilst in the case of chlorine, $-\%\Delta i$ at 2.67 *kV* decreased from −8 in the beginning to −3 after 120 minutes 'ageing'.

Increase in the applied voltage at constant time and increase in the time of exposure to discharge at a constant exciting *k*V lead to the same result as seen above.

36. Potential Inversion of *Joshi-Effect* in SO_2 Gas under Silent Electric Discharge.

U. S. Dhar.

Observations of *Joshi-Effect* were made in pure SO_2 gas when both positive and negative *Joshi-Effect*, $\pm\Delta i$, were observed. The relative *Joshi-Effect* was found to be maximum at small exciting *k*V and decreased by increasing the applied *k*V, in complete agreement with the generality of findings in regard to Δi phenomenon. Furthermore, a moderate increase in the applied *k*V causes a precipitous decrease of Δi. The nature of the excited surface was found to exert a profound influence on the magnitude of the corresponding *Joshi-Effect*. Observations were made in presence of annular films of Na_2So_4, NaOH, SO_2 and $HgCl_2$. A preformed film of Na_2SO_4 does not influence markedly the corresponding *Joshi-Effect*, whilst this is favoured to a great extent by a coat of NaOH. A condensed surface film of SO_2 and a coat of $HgCl_2$ on the annular walls of the ozoniser were found to abolish the *Joshi-Effect* altogether. These results confirm the suggestions due to Prof. Joshi that $\pm\Delta i$ being fundamentally of surface origin, may be poisoned by SO_2 or HgS formed during the experimental conditions.

37. Influence of the Filament Current in the Diode Detection *Joshi-Effect* in Iodine Vapour in contact with Powdered Iodine.

S. N. Tiwari, Banaras.

Joshi observed the profound influence of enhancing the surface/volume ratio on the magnitude and the sign of *Joshi-Effect* by introducing powdered wall material in the discharge space. In the present work the annular space of a Siemens' tube was filled with finely powdered Iodine and the system excited by fields due alternating potential of 50 cycles frequency. The discharge current i was measured by a diode used as a half-wave rectifier. Series of observations were taken for the influence of the filament current on the corresponding Joshi-Effect. This last was positive *i.e.*, showed a photo-increase of current, at low filament currents, At larger currents the effect was ordinarily negative. The results are discussed in terms of the filament-plate capacity and the kinetic energy of the cathode emissions at various filament currents.

38. *Joshi-Effect* in Chlorine under Mixed Electric Discharge.

G. V. Bakore, Jaipur.

Studies of *Joshi-effect*, Δi were made in chlorine in a Siemens Ozonizer excited by A. C. potentials V of 50 cycles frequency over 1 to 2 *k*V. The influence on Δi of ring-metallic electrode, in contact with the excited gas maintained at various unidirectional potentials in the ranges -2.3 to $+2.3$ *k*V, was investigated. The threshold potential V for the A.C discharge is 1.1 *k*Vand glow passes between the ring-electrode and the L.T. of the ozonizer at $+$or-1.7. *k*V.

The general variation of Δi or $\%\ \Delta i$ with applied A.C. potential, $\backsim$V, *viz.* maximum near V_m and a decrease thereafter, is the same at all fixed electrode potentials.

At a constant $\backsim$V; i_D under dark was unaltered when the ring-electrode potential varied between $+$and -1.7 *k*V; under the mixed discharge, however, i_D increases with positive ring-potential and decreases with a numerical increase of the negative potential.

Δi and $\%\ \Delta i$ at a fixed $\backsim$V decrease with increase of $+$ve ring electrode potential and slightly increase with a numerical rise in the negative potential, between $+1.7$ and -1.7 *k*V. Thus *e.g.*, at an $\backsim V = 1.2$ *k*V, Δi 105 decreased to 73 and $\%\Delta i$; 71 to 52 for an increase 0 to $+1.7$ *k*V on the ring; and corresponding to $\backsim V = 1.9$ *k*V, Δi 13 increased to 24 and $\%\Delta i$, 5 to 9.4 for an increase 0 to -1.7 *k*V on the ring. This is attributed to the $+$ve or $-$ve electrode potentials being less or more favourable respectively for the 'space charge' due to negative ion formation responsible for Δi (Joshi, *Phy. Sec.*, A *26*, 1946; *Curr. Sci.*, 1946, *15*, 281).

Under the mixed discharge at a constant $\backsim$V, Δi and $\%\ \Delta i$ increase with numerically increasing ring potential ($+$ or $-$). Thus *e.g.*, at V $=1.7$ *k*V, Δi and $\%\ \Delta i$ increase

80—100 and 27—32 respectively for an increase +2.0 to +2.3 kV on the ring electrode. These results indicate that Δi is characteristic of the electrode-surface and not of the conductivities.

39. Charge and Stability of Colloids—Part XIV. Effect of Non-Electrolytes.

A. C. CHATTERJI *and* RAM NATH.

(1) The effect of non-electrolytes such as propyl alcohol, isopropyl alcohol, butyl alcohol, glycol, glycerol and acetone on the stability of arsenious sulphide sol have been studied. (2) It has been observed that the variations in the coagulation concentration of an electrolyte ($BaCl_2$) and the adsorption of oppositely charged ions of the same electrolyte do not always go hand in hand.

40. Supersaturation of Liquids in Liquids.

A. C. CHATTERJI, RAM GOPAL *and* R. P. RASTOGI, Lucknow.

A brief review of the previous work on supersaturation of liquids in liquids is given, from wlich it appears that the existence of supersaturation in liquid-liquid systems is still an unsettled problem and requires a further thorough and extensive study. With this aim in view a few systems *e.g.* aniline in water, water in aniline, nitrobenzene in water, phenol in water, and O-nitrophenol in water, have been tried. Although the results are not yet conclusive, they appear to show, however, a negligible supersaturation. It is pointed out that existence of a very low interfacial tension probably does not completely account for this phenomenon.

41. Supersaturation Limits of Non-aqueous Solutions—Part I.

A. C. CHATTERJI *and* A. N. BOSE.

Limits of supersaturation in non-aqueous solutions of non-electrolytes have been studied. The value of $(T_s - T)$ has been calculated and these values fall in three different categories. From the values of $(T_s - T)$ the value of the radius of the stable crystal nucleus has been calculated. The value of 'r' has got the same order in different systems *i.e.* the order is 10^{-6} cm.

42. Supersaturation Limits of Non-aqueous Solution—Part II. The effect of heating on the limits of supersaturation.

A. C. CHATTERJI *and* A. N. BOSE.

The effect of heating on the limits of supersaturation of non-aqueous solutions of non-electrolytes has been studied. The effect of heating is observed in most of the systems. The product of concentration (c) and the fluidity ϕ has been calculated. It is found for the systems having ($c\phi$) value more than 30, heating effect is negligible. Certain exception to the $c\phi$ rule are noticed. These are accounted for by the low mutual affinity among the molecules of the solutes.

43. Variation of Relative Viscosity with Temperature—Part IV. Organic Solutes in Non-aqueous Solvents.

A. C. CHATTERJI *and* A. N. BOSE.

The variation of relative viscosity with temperature has been studied. In most of the systems studied here the value of $\frac{\delta}{\delta t}\left(\frac{\eta_s}{\eta_o}\right)$ is negative but for the systems of butyl- alcohol phthalic acid, butyl alcohol-succinic acid and propyl alcohol succinic acid the value of $\frac{\delta}{\delta t}\left(\frac{\eta_s}{\eta_o}\right)$ is almost zero at lower concentrations. This may be due to the fact that the molecules of butyl alcohol and propyl alcohol are less associated than the molecules of methyl alcohol.

44. Variation of Absolute Viscosity with Temperature—Part V. Organic Solution in Non-aqueous Solvents.

A. C. CHATTERJI *and* A. N. BOSE.

The variation of viscosity with temperature of non-electrolytes in non-aqueous solvents has been studied. It has been observed that the simple equation of Andrade $\log \eta = A + B/T$ is applicable to the most of the systems studied here. The value of the constants A and B of the above equation have been calculated and it has been found that A is the same both in aqueous and non-aqueous media while B changes from solvent to solvent.

45. Variation of Absolute Viscosity with Concentration—Part VI. Organic solutes in non-aqueous solvents.

A. C. CHATTERJI *and* A. N. BOSE.

The viscosity of non-electrolytes in non-aqueous solvents has been studied at different concentrations. It has been found that Taimis second equation $ln\ \eta\ \theta + \phi$ is applicable to the most of the systems studied here. The value of the constants, θ and ϕ, of the above equation have been calculated.

46. The Effect of Time and of Concentration on the Syneresis of Sodium Oleate Gels in Pinene and Xylene.

MATA PRASAD *and* V. SUNDARAM, Bombay.

The effect of time and concentration of soap in the syneresis of gels of sodium oleate in pinene and xylene has been studied. Syneresis starts spontaneously immediately after the gel sets. The amount of liquid exuded by the gels at any interval of time since the commencement of syneresis decreases with an increase in (1) the time interval and (2) the concentration of the gel. The gel containing 2 per cent sodium oleate in xylene has been found to behave abnormally. The equation $X^a = Kt$ for the rise of liquids in capillaries is found to be applicable to the process of syneresis, the value of 'a' varies with the concentration of gels; it is greater, the more dilute are the gels.

47. Some Anomalous Dipole Moments.

S. K. K. JATKAR *and* (MISS) S. B. KULKARNI, Bangalore.

Part I Hydrogen and Halogens.

Dipole moment of fluorine, chlorine, bromine and iodine in pure liquid state and that of iodine in various solvents has been calculated by applying the new equation. The small values of the dipole moments 0.01 to 0.4 in the case of hydrogen and halogens have been explained as due to the resonance structure $\overline{X}^- - X^+$. The moments are proportional to the cube of the internuclear distance and the ionic character calculated as $i = \frac{b}{e\gamma}$ varies linearly with r^3. The variation of the moment of iodine in different solvents is ascribed to the loosely bound iodine solvent complexes, which goes hand in hand with the variation of colour of the solvent.

Part II. Symmetrical di- and trisubstituted benzenes.

In continuation of the previous work on the moment of *p*-quinone, *p*-dinitro and *sym* trinitrobenzene etc., the moment of *p*-di—chloro,—bromo and iodo-benzene has been interpreted as due to the resonance in the symmetrical structures, the ionic character being proportional to the square of the distance.

Part III. Hydrogen peroxide, hydrazine and *para* nitroaniline.

The dipole moments of hydrogen peroxide, hydrazine and *para* nitroaniline in pure liquid state as well as in various solvents have been calculated by applying the new

relationship $(\varepsilon-n^2)\frac{M}{d}=\frac{L\pi Nb^2}{KT}$ The moments calculated from pure *liquids and* concentrated solutions indicate the change in kT from 1 kT to ½ kT in the case of H_2O_2, NH_2NH_2 and p-$NH_2C_6H_4NO_2$. The moments 2.1D for H_2O_2 and 1.5D for NH_2NH_2 are explained as due to free rotation along O-O and N-N. The new value moment of para-nitraniline 5.2D is the sum of the moments of aniline and nitrobenzene.

48. Nature of Chemical Bond.—Part III. Molar Refraction of Solids.

S. K. K. JATKAR *and* P K. BHANDARI, Bangalore.

The molar refraction R (Newton) $=(n^2-1\frac{M}{d}$ of solids such as oxides and halides of alkalies and alkaline earths are given by $\frac{4\pi N}{3}r^3\cdot\frac{Za \text{ or } Zb}{(Za+Zb)}v^2$ where r is the interneuclear distance, Za and Zb are the atomic numbers and v the valence. The refraction given by Lorentz Lorenz' formula does not give as concordant results as the Newton's equation. The ratio $Za/(Za+Zb)$ is proportional to the partial ionic character given by dipole moments.

49. Formation of Formaldehyde during the Interaction of Carbon Monoxide and Hydrogen under Silent Electric Discharge. Part II. Influence of the Semi-ozoniser Excitation.

R. N. SAHASRABUDHEY *and* T. V. SATHYAMURTHY, Banaras.

The arrangement of the apparatus was the same as described earlier (*Proc. Ind. Acad. Sci., 27*, 366), but instead of a Siemens' ozoniser a wire-in-cylinder type of discharge tube—the semi-ozoniser—was used as the reaction vessel.

Experiments were conducted with CO-H_2 mixtures in 1: 1 ratio, at 9.6 *kV* and 500 cycles with the semi-ozoniser excited electrically in the normal and the reverse manner. In the former the inner electrode (the axial copper wire) served as H.T. and the winding on the glass outside as the L.T., and in the latter vice-versa. In neither set of experiments was the quantity of formaldehyde enough to permit quantitative estimation, although in the latter case evidence of its formation was decisive as indicated by Schiff's test. This is suggestive, perhaps, of the important role of the *surface* in this reaction.

50. Behaviour of Carbon Monoxide under Silent Electric Discharge: Influence of Temperature.

T. V. SATHYAMURTHY *and* S. M. DESHPANDE, Banaras.

Investigations on the behaviour of carbon monoxide under silent electric discharge reported earlier (*Proc. Ind. Sci. Cong., 33*, Part III. *Chem. Sec.* Abst. No. 52) have now been extended with respect to the influence of temperature.

Pure carbon monoxide filled at different pressures *viz.*, 230, 300 and 400 mm in Siemens' glass ozoniser was subjected to silent electric discharge at appropriate threshold potentials and 500 cycles frequency. Time variation of the pressure was observed at 30°, 40°, 50°, 60°, and 70°C respectively.

On switching on the electric field there is a continuous but gradually decreasing fall in pressure until a steady equilibrium pressure is reached. This fall in pressure is ascribed to the self-condensation of CO. It is directly proportional to initial gas pressure. The time taken to reach the equilibrium pressure also decreases with rising temperature indicative of an over-all increase of the rate of change with temperature. The last factor is, however, unfavourable to condensation of carbon monoxide as such under the change, which is also to be anticipated from general theories of polymerization and condensation.

51. Influence of Ultraviolet Light on the Capacity of Electrodes in an Electrolyte at Low Frequency.

D. SINGH *and* U S. NANDI, Banaras.

The measurement of capacity of electrodes placed in an electrolyte at different frequency was carried out by means of a Wheatstone's bridge of the alternating current type in dark and under ultraviolet radiation. Two valve transmitters with 6L6 were designed and the beat frequency (usually 600 to 1520 cycles/second) was employed as the the source of alternating current for the bridge. The source of ultra violet light was a quartz mercury vapour lamp working at 220 volts and 2.5-2.7 amperes current; it was placed at a distance of 25 cms from the electrolytic cell. The electrolytes used were hydrochloric acid and silver nitrate of various concentration contained in a silica cell, with two bright platinum electrodes of 1 sq.cm area fixed vertically, the inter-electrode distance being 2.2 cms. It is observed that the capacity decreases as the frequency increases. When the values of the capacity were plotted against the square of the corresponding frequencies the curve obtained was a hyperbola, the general equation is $xy+dx+\beta y=K$. When the electrolytic cell was irradiated with ultra-violet light at constant frequency the capacity decreases; the percentage decrease in capacity diminishes with the increase of frequency.

52. A New Photo Compound of Anthracene.

(Miss) K. K. ROHATGI *and* S. N. MUKHERJEE, Jadavpur.

In course of the study of the quenching of fluorescence in non-aqueous solvents by organic quenchers, it was observed that by irradiating a soln. of anthracene in CCl_4 with ultraviolet light ($\lambda=3650$A) there was evidence of the formation of a photo-compound. After a period of slow reaction, the process went on with an accelerated rate as studied by the rise in fluorescence intensity with time of 3 hours. With the progress of reaction, wave-length of the emitted light changed from violet to blue (4200 $\rightarrow$4650A) and the region of max. absorption shifted towards the shorter wave-lengths.

In pure CCl_4 the reaction proceeded slowly, never reaching an appreciable fluorescence intensity. But with the addition of increasing amounts of C_6H_6, the reaction appeared to be accelerated, although in pure benzene soln., evidence of a late reaction was observed on prolonged exposure.

The above interaction is being followed by absorption study in a spectrograph and also by measuring the percentage transmission of incident radiation by means of a photocell in Lumetron colorimeter.

53. Silver Catalysis, Basic Catalysis, and Catalysis by undissociated Molecules of acetic acid in the reduction of Silver Ion by Ferrous Ion.– Part A.

BAL KRISHNA *and* SATYESHWAR GHOSH.

A detailed study of the reaction between silver ion and ferrous ion has been made. The order of the reaction is dependent upon the quantity of silver which is a reaction product and which remains in a state of continuous flux owing to a simultaneous formation and precipitation of colloidal silver. The reaction is trimolecular where the catalytic surface increases proportionately with the mass of silver reduced. If we omit silver catalysis from consideration, the specific reaction rate shows tendency towards bimolecularity.

Apart from silver, a number of other very important factors are involved which control the reaction velocity :–

(1) Basic ions, like carbonate, acetate, and borate exert a strong accelerating effect upon speed of the reaction.

(2) For a given pH *i.e.* at a constant acid base ratio, it has been shown that speed of the reaction is independent of hydroxyl ion concentration, but depends upon total concentration of the buffer. In other words the reaction shows the phenomenon of *general base catalysis.*

(3) Undissociated molecules of acetic acid play the role of a positive catalyst.

(4) In contradiction to the existing view it has now been definitely established that Hydrions retard the reaction velocity.

54. Silver Catalysis, Basic Catalysis, and Catalysis by undissociated Molecules of Acetic Acid in the Reduction of Silver Ion by Ferrous Ion — Part B.

BAL KRISHNA *and* SATYESHWAR GHOSH.

The reaction between silver ion and ferrous ion is the first instance from the inorganic reactions which shows the presence of general base catalysis. The present concept of acids and bases and acid-base catalysis as given by Bronsted is inadequate to explain the presence of basic catalysis as shown in the reduction of silver ion by ferrous ion. The present concept of acids and bases needs revision in order to meet the demands of experimental kinetics observed here.

Further, the reaction between silver ion and ferrous ion shows that the catalysis by hydrions is different from that of undissociated molecules of an acid. Bronsted's assumption *viz.* that the catalysis by undissociated molecules of the acids is identical with catalysis by hydrogen ions, is erroneous.

55. On the Question of the Existence of a Definite Base Saturation Limit of Layer-lattice Silicates.

R. P. MITRA *and* K. S. RAJAGOPALAN, Delhi.

Many layer-lattice silicates including the so-called clay minerals readily take up cations (or, bases) from 'contact' solutions. As a rule the greater the valency and the concentration of the cation and the higher the pH of the solution, the larger is the amount of cations taken up by the solid phase. This raises the important question as to whether a definite base saturation limit in the case of these silicates at all exists and, if so, on what factors it depends. Investigations on hydrogen mica obtained by replacing the exchangeable K ions of finely ground muscovite by H ions show that such a limit does exist and the limiting value indicates the total amount of cations taken up by the solid in exchange for (a) the H ions on the surface of the platelets acquired by the replacement of the exposed K ions by H ions in preparing the hydrogen mica, and, (b) H ions dissociated from the OH groups of the mica lattice which have become exposed through hexagonal rings of oxygens as a result of grinding the mineral. The amounts of both these categories of H ions can be accurately determined from two sharp inflexions in the potentiometric titration curve of the hydrogen mica with a strong base (Mitra and Rajagopalan, *Nature*, 1948, p: 104).

56. On the Alleged Cation Binding Power of the so-called Broken Bonds of Layer-lattice Silicates.

R. P. MITRA *and* K. S. RAJAGOPALAN, Delhi.

The layer-lattice silicates *e.g.*, micas, being crystals of the ionic type, their mechanical comminution must give rise to sheets terminating in equal numbers of positively and negatively charged ends, or, poles at the lateral surfaces and if the negative ends of the broken bonds should at all remove cations from a contact solution as postulated by some investigators, the positive ends must simultaneously take up an equal number of anions as otherwise more anions than cations would be left in the liquid phase when the solid is separated from it, *e.g.*, by filtration. Experments with finely ground mica show that anions like Cl' and SO_4'' are not at all taken up by the solid though it does remove appreciable quantities of cations from the solution. Apparently, the broken bonds cannot be held responsible for the cation binding power of the ground mineral. On the other hand, the observed cation binding capacity can be completely accounted for if it is recognised that the cations are simply taken up in exchange for (a) the exposed K ions of the mica particles and, (b) H ions dissociated from the OH groups of the lattice which have also become exposed through hexagonal rings of oxygens as a result of the grinding. Both (a) and (b) can be accurately estimated, (a) by extracting the potassiums with a dilute mineral acid and analysing for K in the acid extract, and (b) by potentiometric titration of the mica with a strong base. The maximum quantity of cations which is taken up from a salt solution is then found to be equal to the sum of (a) and (b).

57. Some Common Electrochemical Features of Kaolinite and Asbestos.

R. P. MITRA *and* K. S. RAJAGOPALAN, Delhi.

The 2.0 micron fraction separated from ground asbestos (a Merck specimen) on being leached with dilute HCl gave in the leachate 14.0 milliequivalents of Ca reckoned per 100 gms of the mineral. Potentiometric titration of a 1.0 percent aqueous suspension of the resulting 'hydrogen' asbestos with NaOH gave two marked inflexions at *p*H's 8.7 and 10.0. The base combining capacities calculated (in terms of milliequivalents per 100 gms of dry matter) at the second and first inflexions were as 2:1. Similar observations had been previously made on the mineral Kaolinite (Mitra, Bull. No 4, *Indian Soc. Soil Science*, 1942, p 41). This similarity is in harmony with the recent finding from x-ray studies that in respect of its lattice structure, asbestos resembles the platy mineral, Kaolinite, more than the double-chain silicates, amphiboles.

58. An Electrochemical Method for the Identification of Illite in Soils and other Argillaceons Sediments.

R. P. MITRA *and* K. S. RAJAGOPALAN, Delhi.

Identification of the clay mineral, illite, in soil and other argillaceons sediments, e.g., shales, is usually done by x-ray and thermal methods. An unequivocal differentiation from the other allied mineral, montmorillonite, is often difficult to make using, even, the x-ray technique. Quite dependable criteria have, however, been found to be provided by the electrometric titration curves of the hydrogen or, acid forms of the two minerals. Hydrogen montmorillonite, as a rule, shows only one pronounced inflexion in its titration curve with NaOH, or, KOH at about pH 8.5. Hydrogen illite, on the other hand, gives as many as three inflexions, one at about pH 6.5, and the other two at pH's nearly 8.0 and 10.5. The base combining capacities calculated (in milliequivalents per 100 gms of the hydrogen illite) at the third and second inflexions are as 3:1. Similar features are shown by (the acid form of) mica itself in a finely ground state (Mitra and Rajagopalan, *Nature*, 1948, p. 104). This similarity confirms the essentially micaceous structure attributed to illite on the basis of x-ray studies.

59. Drought Resistance of Plants in Relation to Hysteresis in Sorption. 1. Hydration and Dehydration of the Leaves of Certain Drought Resistant and Drought Sensitive Plants.

K. SUBBA RAO, M. BHIMASENA RAO *and* B. SANJIVA RAO, Bangalore.

A new approach to the problem of drought resistance of plants has been made from the point of view of Hysteresis in Sorption. Balsam, Grass, Paddy, Ragi, Wheat and Oats were chosen for the study. The leaves of these plants were subjected to successive dehydration and hydration in a quartz fibre spring balance.

Hysteresis effect is observed in all the systems and the hysteresis loop disappears after a certain number of hydrations and dehydrations. In the early stages, the capillaries of the leaf are made up of fairly rigid walls. The cavities entrap water and cause hysteresis. The entrapping effect is due to the rigidity of the leaf tissue. It is likely that this rigidity of the leaf tissue is a factor of importance in enabling the plants to conserve water during periods of drought.

On successive hydration and dehydration of the leaf, there is a fall in the hydration capacity at saturation pressure. This is due to the denaturation of the protoplasm and a decrease in the hydrophilic character.

The relative positions of the hydration isotherms of the leaves indicate that in the relative humidity range of 0.5-0.95 the six plants show a gradation in the water holding capacity. At any particular humidity in this range, balsam takes the lowest and Oats the highest amount of water. The six plants can be arranged in the increasing order of drought resistance as follows,—Balsam, Grass, Paddy, Ragi, Wheat and Oats. Balsam is the least and Oats the most drought resistant. In accordance with the cavity theory of sorption hysteresis, there is in balsam a preponderence of wider cavities and in Oats narrower ones.

60. Drought Resistance of Plants in relation to Hysteresis in Sorption. II. Adaptability of the Ragi Plant to varying Conditions of Soil Drought.

K. SUBBA RAO, M. BHIMASENA RAO *and* B. SANJIVA RAO, Bangalore.

The principle of adaptability of drought sensitive plants to severe drought conditions is one of great importance and has been extensively studied by Russian workers. Whether during this adaptation, any change is produced in the capillary structure of the leaf has been studied with reference to Ragi as the experimental plant. Ragi plants A, B, C, and D were grown in soil droughts of 65%, 47%, 40% and 36.5% respectively of the total water holding capacity of the oil. There was a marked difference in the growth, height and yield of the four plants.

When the plants were 80 days old, the blades were removed and subjected to a series of dehydrations and hydrations at 30°C in a spring balance. Hysteresis is exhibited in all the cases. The hydration dehydration isotherms and the hysteresis loops are nearly coincident. These indicate that the cavities and open pores in the blades of the four plants are almost of the same size.

There is however a regular variation, though small, in the smallest cavity neck radius. The radius in D is smaller that that in A, those of B and C being intermediate between these two. It is probable that by extending the treatment of exposure of the plant to severe drought over a number of generations, the small differences to the capillary structure of the leaves may become more prominent.

The amount of water lost in the initial dehydration of the leaves seems to be related to the age of the plant. The leaves of 80-day old plants lost approximately 350 gms. of water per 100 gms. or dry leaf, whereas those of 120-day old plants lost 255 gms.

61. Hysteresis in Sorption. XVII. Sorption of water on hardened sericin (silk gum).

K SUBBA RAO, M. BHIMASENA RAO, A. R. VASUDEVA MURTHY *and* B. SANJIVA RAO, Bangalore.

The behaviour of sericin with regard to the hysteresis effect in the sorption of water has already been indicated (*Proc. Ind. Sci. Congress*, 3,56,1946). The behaviour of sericin hardened by formaldehyde and basic chromium sulphate has now been studied. The hardened sericin was subjected to a series of hydration and dehydration at 30°C. A permenent hysteresis loop has been obtained Tde loop has been reproduced at the 9th cycle of hydration and dehydration with formaldehyde hardened sericin and at the 8th cycle with chromium sulphate hardened sericin.

A permanent and reproducible hysteresis loop is characteristic of a rigid gel (Rao K. S., *J. Phys. Chem.* 500.45,1941) whereas a dwindling and disappearing loop is characteristic of an elastic gel with solvating liquids. Sericin is an elastic gel like casein, egg albumin and gelatin (Rao G. N., Rao K. S., and Rao B. S., *Proc. Ind. Acad. Sciences* 221, 25, 1947), rice grain (Rao K. S., *Current Science* 266, 8, 1939) and gum arabic (Rao K. S., *Current Science* 19, 9, 1940) in losing the hysteresis loop initially exibited in the sorption of water. On hardening, sericin loses its swelling property and behaves like a rigid gel. The cavities entrap water during dehydration and cause hysteresis. The entrapping effect persists even in the subsequent cycles of hydtation and dehydration.

62. Compression-expansion Hysteresis in Surface Films.

K. SUBBA RAO *and* B. SANJIVA RAO, Bangalore.

By employing the Adam surface pressure balance, the compression-expansion hysteresis of the films of sericin and egg albumin has been studied. The expansion curve is always below the compression curve and the hysteresis loop is reproducible. The loop has been scanned by subjecting the film to expansion at different points on the compression curve and to compression at different points of the expansion curve. The expansion scanning curves reach the low pressure end of the loop and the compression scanning curves reach the high pressure end. The compression-expansion hysteresis effect and the characteristics of the scanning curves are probably connected with the difference in the degree of hydration of the protein film.

Below the collapse point, the stearic acid film shows no hysteresis on compression and expansion. Above the collapse point however, the compression expansion curves do not coincide and the hysteresis loop obtained is nonreproducible.

63. Adsorption of Dyes on Mercury Surface.

D. D. KARVE, K. K. DOLE *and* B. W. KELKAR, Poona.

Study of the adsorption of different dyes on the surface of mercury has given very interesting results and some of them have been described in the present paper. Mercury-coated copper plates were suspended in aqueous solutions of different water-soluble dyes, for different time intervals and different concentrations of the dyes. The adsorption of the dyes was determined colorimetrically after washing the plates with pure double-distilled water and removing the adsorbed dye by N/10 acetic acid solution and estimating the dye in the acetic acid wash.

In general, adsorption increases with increase in the concentration of the dye, until the saturation of the surfaces is reached. It is observed that the adsorption varies with time and curves of the adsorption coefficient against time exhibit breaks at certain intervals. This indicates that the multi-layer theory of McBain is corroborated in these observations.

It is significant that in the case of neutral red colour of the solution changes to yellowish red, after adsorption by a mercury-coated copper plate. If the same yellow solution is used for adsorption by a fresh mercury plate, the adsorption coefficient increases, while Rubin S behaves exactly in the opposite way. Methyl orange behaves probably in the same manner as the neutral red except that the colour change is not observed.

In alkaline medium adsorption of neutral red substantially increases while the presence of acetic acid in the solution has no influence on the adsorption. Alkaline medium has the adverse effect on the adsorption of Rubin S.

Under identical conditions following is the order of increasing adsorption.

Rubin S ——— Neutral Red ——— Methyl Orange.

Further work with other dyes is in progress.

64. Semipolar Single Bond—Part III. Ratio of specific heats for gases.

SAIYID SHAMIM-AHMAD.

The anomaly of the ratio of the specific heats for coloured diatomic molecules is put forward to support the hypothesis of the semipolar single bond—a hypothesis which also explains the reactivity and colour of these anomalous molecules. The influence of substitution on the value of γ is explained as also that of temperature. This decrease in γ is correlated with increase in reactivity at higher temperatures and both are shown to be due to the presence of the semipolar single bond. Dissociation into atoms is ruled out as the cause of increase in reactivity.

65. Semipolar Single Bond—Part IV. Semipolar Single Bond and Pauling's scale of Electronegativities—Part I.

SAIYID SHAMIM-AHMAD.

In the present paper an attempt is made to point out the defects of Pauling's interpretation of Electronegativity Scale on the basis of the concept of the semipolar single bond. The results of Pauling's approach are criticised on the basis that the bond type in the elements may be different from that in the compounds and secondly that the results obtained from Pauling's interpretation are highly surprising and sometimes clearly against facts. Most evident are the cases of the alkali hydrides and the coloured molecules. The calculations of the ionic percentage of bonds is open to the serious question as Pauling supposes the covalent molecules to have more than 50% ionic character whereas many salts are supposed to be mainly covalent in nature.

66. Supersaturation Limits of Solutions—Part VII. The Influence of Apparent Ionic Volume and Similar other properties of Ions on the Facility of Spontaneous Crystallisation of Electrolytes from Aqueous Solutions.

RAM GOPAL, Lucknow.

It is shown that, in general, the electrolytes with large apparent equivalent volumes should crystallise out with ease and those of small apparent equivalent volumes should crystallise out with difficulty from aqueous solutions, A number of examples have been cited in support of this statement. Influence of other propertics e.g, entropy etc., similar to apparent equivalent volume, of electrolytes on spontaneous crystallisation has also been referred to in this communication,

67. Supersaturation Limits of Solutions—Part VIII. The Physical Significance of the Constancy of the Expression $(T_s\text{-}T)\lambda$.

RAM GOPAL, Lucknow.

Considering the heat of solution λ of the solute as its lattice energy when kept in contact with water, an explanation of the constancy of the expression $(T_s - T)\lambda$, found experimentally in many cases, has been advanced.

68. Influence of Oxidising Agents on the Adsorptive Power of Charcoal: I. Potassium Permanganate.

SUDHAMOY MUKHERJEE *and* SUKHAMOY BHATTACHARYA, Calcutta.

A study has been made of the variations of the adsorptive powers of activated and non-activated charcoals on boiling with 0.02N, 0.1N, 1.0N and 25N solutions of potassium permanganate. The adsorptive powers of both types of charcoal for methylene blue, iodine, caramel and acetic acid (only for non-activated charcoal) at first increase and then decrease on gradually increasing the concentration of permanganate and the optimum occurs with 0.1N solution. Non-activated charcoals are more susceptible to activation than activated ones. No further change is noticed on raising the concentration above 1.0N. Alkaline permanganate behaves in the same manner as acid permanganate.

The treatment of charcoal with potassium permanganate is accompanied with chemical interaction, involving the reduction of permanganate and oxidation of carbon to carbon dioxide. It has been suggested that 'activation' and 'over-activation' produced by the oxidation of the surface carbon atoms by permanganate bring about the observed effects.

69. Adsorption Method of Separating Constituents of Mixture.

M. GOSWAMI *and* B. K. MUKHERJEE.

Activated carbon and silica gel were tried as adsorbents. Silica gel prepared by different methods and having different pore space were tried. A constant boiling point mixture of 15% Methyl Alcohol and 85% Acetone by volume was the adsorbate. It has been observed that Carbon has preferential affinity for MeOH but Silica Gel preferentially adsorbs Acetone from the mixture and that the adsorption is more marked in the liquid phase than in the vapour phase. Previous works in this direction have been confined to mixtures of the same series of compounds consisting mostly of lower and higher boiling fractions of hydrocarbons and also on the adsorption of Methyl Alcohol and Acetone separately by Carbon or Silica Gel. Conclusions of previous workers that the higher the molecular weight and the lower the volatility of a substance the greater is its tendency to adsorb any solid can not be applicable in the present case as MeOH is of lower volatility and also of lower molecular weight than Acetone. Mixtures of the nature dealt with in the present work are often obtained in industrial practice and there exists no suitable method of separation specially when one of the constituents present is small in amount in comparison to the other.

70. The Ternary System Ag_2O—Per-iodic Acid—Water at 0°C.

P. P. GYANI, Patna.

The ternary system Ag_20—Per-iodic acid—water has been studied at 0°C. Three solid phases of compositions $5Ag_20.1_20_7$, $2Ag_20.1_20_7$, $3H_20$ and $Ag_20.1_20_7.4H_20$ have been shown to exist. The first two compounds have been isolated in the pure state and their composition studied. The Compound $Ag_20.1_20_7.4H_20$ is stable only in presence of excess of per-iodic acid and is decomposed by pure water with the separation of the compound $5Ag_20.1_20_7$.

71. Theory of Ash Determination by two Conductance Measurements.

K. S. G. DOSS *and* K. K. GUPTA.

For calculating soluble ash % of sugar and sugar-products from electrical conductance measurements, Zerban and Sattler have suggested an empirical equation of the form—

$$\text{Ash } \% = \frac{k}{M}\,[1+px-qy] \qquad \text{(A)}$$

where, M, p & q are constants

$$x = \frac{1}{K} \;\&\; y = \frac{K_1}{K}$$

K—Sp. conductance of sugar solution (5 gm. in 100 ml.) at 20°C.
K_1—Sp. conductance of acidified solution (200 ml. of above solution + 5ml. of 0.25N HCl) at 20°C.

The above equation though evolved empirically, yields good results agreeing very well with the soluble ash determined by the chemical method. In the present work, the following equation has been derived on theoretical considerations :—

$$\text{Ash } \% = \frac{k}{M}\left[1+px-qy+\frac{(qy-px)^2}{1-px+qy}\right] \qquad \text{(B)}$$

Equations (A) and (B) are of the same form excepting for the term $\frac{(qy-px)^2}{1-px+qy}$

Even in extreme cases, the term was examined and found to be negligibly small as compared with the main term. Thus it is quite clear from the above discussion that empiricial equation of Zerban and Sattler can be supported theoretically. The significance of the constants in Zerban and Sattler Equation has been discussed.

72. Kineties of Development of Colour in Sugar Solution.

K. S. G. DOSS *and* S. K. GHOSH.

An important cause of colour in sugar obtained from sugarcane is the caramelisation of reducing sugars during the sugar boiling process. A study of Kinetics of caramelisation was therefore undertaken. The colour development was studied by using a recording photo-electric sepectrophotometer.

The results show (1) that the absorption by heated solution of invert sugar continuously increases from the red to the blue end of the spectrum, (2) that the intensity of colour developed increases with the time of heating, (3) that the rate of colour development is not proportionate to the time of heating but is apparently autocatalytic and (4) that the sate of colour development in the initial stage of reaction is nearly proportional to the concentration of invert sugar but after the reaction has proceeded for about an hour the rate of colour development is much higher in the more concentrated solution.

73. **Formation of Formaldehyde during the Interaction of Carbon Monoxide and Hydrogen under Silent Electric Discharge:—Part I. Influence of Temperature.**

R. H. SAHASRABUDHEY *and* T. V. SATHYAMURTHY, Banaras.

The investigations reported earlier in these Absts. (also *Proc. Indian Acad. Sci.* 27, 366), have been extended.

The carbon monoxide-hydrogen mixture (ratio 1:1 by volume) at atmospheric pressure was circulated through a Siemen's glass ozoniser heated to different temperatures and subjected to silent electric discharge at an exciting potential of 9.6kV and 500 cycles frequency. Formation of formaldehyde was observed at 0.5°, 15°, 20°, 32°, 40°, 50°, 60° and 80°C.

The reaction velocity as judged by the volume of the gas mixture used up *viz.*, 415 cc at 0.5°C and 900 cc at 80°C appears to increase directly with temperature. The absolute yield of formaldehyde, however, is greatest- 0,057 gms- at 0.5°C and progressively decreases with rising temperature to 0.023 gms at 80°C.

The lower yields at higher temperatures cannot be due either to polymerization of formaldehyde (Auerbach and Pluddemann, 1914, *Ai*, 488) or to self-condensation of carbon monoxide as reported separately in these abstracts. It appears that formaldehyde which is the primary product of the reaction is destroyed irreversibly by secondary changes accelerated by rising temperature.

74. **Molecular Radii of Lac and other natural Resins.**

S. K. K. JATKAR *and* B. R. Y. IYENGAR, Bangalore.

The dielectric constant data on lac, manila copal, dammer and mastic resins have been utilized to calculate the 'molecular radii' by applying the new equation. An error in the previous interpretation of Bhattacharya has been pointed out. The molecular sizes follow the trend, mastic > manila copal > dammer > lac.

75. **Supersonic Velocity in Gases and Vapours. (Dispersion in Carbondioxide).**

S. K. K. JATKAR *and* R. J. SUJIR, Bangalore.

Velocity of sound in carbondioxide was measured by the supersonic method. While at room temperature the velocity was normal at 22 Kc/s, at 50 Kc/s there is a dispersion. However at 134°C at the same frequency the velocity was normal. Higher temperatures tend to displace the dispersion to higher frequency ranges.

76. **Potentiometric Titrations of Oxidation Reduction Systems.**

S. K. K. JATKAR *and* S. K. RAMASWAMY, Bangalore.

The potentiometric titration of mixtures of hydrogen peroxide, Caro's acid and persulphuric acid with sodium sulphite and permanganate has been carried out with a view to check the analysis by the usual Standard method and of Bodin's, Gleu's, Wolfstein and Makow's. It was found to be in satisfactory agreement with the Standard method.

77. **Oxidation Reduction Potential of Hydrogen Peroxide, Caro's Acid and Persulphuric Acid.**

S. K. K. JATKAR *and* K. S. RAMASWAMY, Bangalore.

Using the above equpiment the oxidation reduction potential of hydrogen peroxide, Caro's acid and persulphuric acid at various pH has been measured and compared with theoretical values.

78. A Simple Laboratory Amplifier.

S. K. K. JATKAR *and* K. S. RAMASWAMY, Bangalore.

The paper gives the details of mains driven push pull valve electrometer circuit suitable for the accurate measurement of pH and of oxidation reduction potentials using ordinary radio tubes, a Tinsley vernier potentiometer and unipivot galvanometer.

Organic Chemistry.

79. Sulphur Dyes and Suphurised Vat Dyes: Part II. Constitution of Cibanone Yellow R.

K. N. SHAH, B. D. TILAK *and* K. VENKATARAMAN, Bombay.

The invalidity of the constitution proposed by Fierz-David and Geering (*J. Soc. Dyers Col.*, 1935, *51*, 50), for Cibanone Yellow R, a dye which is noted for its catalytic activity in the photochemical degradation of cellulose, is discussed. The purified dye, assumed to be homogeneous by Fierz-David, has now been shown by chromatography to be a mixture of several substances. The major fraction crystallised in curved orange needles, m.p. 368-70°, regarded as the essential tinctorial constituent of Cibanone Yellow R. Anthraflavone was among the other products isolated.

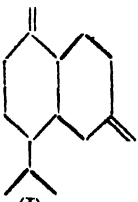
Elementary analysis of pure Cibanone Yellow R corresponds to the empirical formula $C_{45}N_{20}O_7S$, corresponding to three methylanthraquinone residues for one atom of sulphur. Reductive desulphurisation of the pure dye by treatment with Raney nickel and pyrolysis with zinc dust indicate that 2-methylanthraquinone molecules are linked together through the methyl groups by means of sulphur, as against the methane bridge between anthraquinone groups in the constitution proposed by Fierz-David.

A new structure for Cibanone Yellow R and the probable mechanism of its formation from 2-chloromethylanthraquinone are suggested.

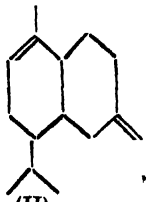
80. Structure of the Cadinenic Sesquiterpene Present in the Oil from the Oleo-resin of Hardwickia Pinnata.

SUKH DEV *and* P. C. GUHA, Bangalore.

The dextro-rotatory sesquiterpene of *Hardwickia Pinnata* oil has been shown to be a mixture of two isomeric hydrocarbons, (I) and (II).



(I)



(II)

The above structures have been arrived at after detailed investigations. The results of dehydrogenation and ozonisation have confirmed the above structures. The position of the nuclear double bond has been established by an extension of Ruzicka and Sternbach's method.

81. On a New Synthesis of Penicillamine.

D. B. DUTT *and* P. C. GUHA, Bangalore.

Acetone has been condensed with hippuric acid, in the presence of anhydrous sodium acetate, acetic anhydride and a trace of pyridine to give 2-phenyl-4-ispropylidene-oxazol-5-one in 60% yields. The oxazolone is readily converted to β, β-dimethyl-

α-benzamido-acrylic acid or ester by water or the corresponding alcohols. Condensation of the oxazolone, acrylic acid and the methyl ester has been studied with thioacetic acid alone and in the presence of peroxides, alkoxides, sulphuric acid and piperidine as catalysts. In the absence of catalysts and in the presence of peroxides no reaction takes place at lower temperature while cyclisation of the acrylic acid takes place at higher temperature. In the presence of sulphuric acid a small trace of a new compound is formed which appears to be N-benzoyl-S-acetyl penicillamine. In the presence of piperidine condensation proceeds smoothly and on hydrolysis gives a compound which conforms with all the colour reactions of penicillamine. Work is in progress to confirm the structure of the amino-acid, which appears to be *dl*-penicillamine.

82. Schiff's Bases of 4:4'-Diamino Diphenyl Sulphide.

M. RAGHAVAN, B. H. IYER *and* P. C. GUHA, Bangalore.

Raiziss *et al.* (*J. Amer. Chem. Soc.*, 1939, *61*. 2763 and *Proc. Soc. Expil. Biol. Med.*, 1938, *39*, 339) have shown that although the therapeutic properties of 4:4'-diamino diphenyl sulphide and its acetyl derivative compared favourably with those of sulphanilamides, their high toxicity precluded their clinical use. The Schiff's bases of sulphanilamides and N¹-substituted sulphanilamides have all been found to be very effective against bacterial infections. (Molitov and Robinson: *J. Pharmacol.*, 1939, *65*, 405).

With a view to testing their activity, a number of Schiff's bases of 4:4'-diaminodiphenyl sulphide with melting points indicated below in parenthesis after each aldehyde, have now been prepared by reacting it with the following aromatic aldehydes. (1) Benzaldehyde, m.p. 176-177°, (2) m-nitrobenzaldehyde, m.p. 159-160°, (3) p-dimethylamino benzaldehyde, m.p. 231-232°, (4) p-diethylamino benzaldehyde, m.p. 155-156°, (5) salicylaldehyde, m.p. 207-208°, (6) anisaldehyde, m.p. 204-205°, (7) 3:4-methylene-dioxybenzaldehyde, m.p. 175-176°, (8) cinnamaldehyde. m.p. 178-179°, and (9) furfural, m.p. 103-104°.

83. Action of Nitrous Acid on Aryl-biguanides.

H. L. BAMI, Bangalore.

Pellizzari (*Gazz. Chim. Ital.*, 1921, *15*, I, 224, 140) has obatined cyanoguanidine, and *o*-phenylene-cyanoguanidine from biguanidine and *o*-phenylene-biguanide respectively by the action of nitrous acid in aqueous solution. During the course of work on substituted biguanide derivatives as potential antimalarial, attempts were made to convert arylbiguanides into arylcyanoguanidines (important intermediates for biguanide synthesis) by this method. *p*-Chlorophenylbiguanide when reacted in cold with nitrous acid led to the formation of *p*-chlorophenylguanylurea instead of the corresponding substituted cyanoguanidine. While in the case of phenyl and *p*-anisyl-biguanides, acid insoluble (giving picrates) but alkali soluble products have been obtained which are being further investigated. *p*-Nitrophenylbiguanide also behaved like *p*-choloro-phenylbiguanide when treated with nitrus acid under similar conditions. The nature of substituents seems to have an important bearing on the course of reaction, in the case of negative and positive substituents in the phenyl ring of the arylbiguanide.

84. Condensation of methone with anthranilic and substituted anthranilic Acids.

T. S. SIVASWAMI *and* B. H. IYER, Bangalore.

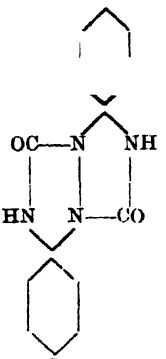
Methone has been condensed with anthranilic and N-methyl-, N-phenyl- and 4-methyl anthranilic acids to yield the corresponding N-(3'-keto-5'-dimethyl-3'; 4'; 5'-tetrahydro)-phenyl-anthranilic acids. The products from anthranilic and 4-methyl anthranilic acids have been cyclised by sulphuric acid to the corresponding 1-keto-3-dimethyl 1; 2; 3; 4-tetrahydroacridones. When the reactants were fused together at high temperatures, the same acridones were obtained at one step. Clemmensen reduction of both the acids and acridones has been attempted.

85. Crisscross Addition to Cyclohexanonazine.

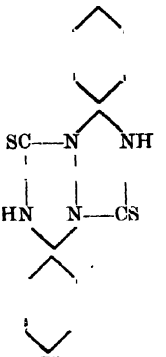
D. B. DUTT *and* P. C. GUHA, Bangalore.

Bailey and Moore (*J. Amer. Chem. Soc.*, 1917, *39*, 279) and Bailey and McPherson (*ibid*, 1917, *39*, 1322,) found that two molecules of cyanic acid, thiocyanic acid and

phenyl isocyanate add to one molecule of benzalazine at the 1,3-positions giving substituted bitriazoles. 'Crisscross addition' was the name suggested to this type of addition. So far Crisscross addition to azines of the type R. CH=N–N=CHR alone has been studied. For the first time the reaction has been extended to ketazines. Cyclohexanonazine has been found to add two molecules of cyanic and thiocyanic acids giving compounds (I) and (II) respectively. Maleic anhydride too adds up very readily to the Ketazine giving a white amorphous product melting at 283°C.



I
m.p. 206°C



II
m.p. 205°C

86. Studies in Antimalarials:—Part I. Some Heterocyclic Substituted Arylbiguanides.

H. L. Bami *and* P. C. Guha, Bangalore.

With the discovery of paludrine (N_1-p chlorophenyl-N_5-isopropylbiguanide), as a potent antimalarial, sufficient interest has been developed in the field of substituted biguanide derivatives in order to discover a better drug. The replacement of p-chlorophenyl part of paludrine with other heterocyclic groups (May *et al.*, *J. Org. Chem.* 1947, 12, 869) has resulted in inactive compounds. Considering the point that p-chlorophenylbiguanide chain is perhaps a basic unit for activity in this type of compounds, various potential substituents were tried at N_5-position of the biguanide chain (Bami, Iyer and Guha; *J. Indian Inst. Sci.*, 1947, *29A*, 15; 1948, *30A*, 1-16; Roy, Iyer and Guha, *Curr. Sci.*, 1948, 7 126; upta *et al.*, *ibid.*, *53*, 185) of which some have shown encouraging activity.

This work has now been extended by preparing various N_5-p--R-substituted phenyl N_5-2-thiazolyl biguandies (R=H, Cl, Br, Me etc.) obtained by the interaction of p-substituted phenyl-cyanoguanidines with 2-amino-thiazole hydrochloride in alchol. A number of other amino-heterocyclics have also been tried for this reaction without success.

87. Studies in Antimalarials:—Part II. N^1—Aryl-N^5-alkyl-biguanides.

H. L. Bami *and* P. C. Guha, Bangalore.

A number of substituted biguanide derivatives have been prepared in order to find drugs having antimalarial activity better than that of paludrine (Studies in antimalarials part I ; these abstracts). In all such cases the biguanide chain has been loaded with various complex molecules and these compoumds have not shown great promise. It was therefore considzred worthwhile to study simpler substituents at the either end of a biguanide chain.

Consequently various isomers and analogues of plaudrine were prepared where the effect of the chlorine atom in the different positions in the phenyl ring, the effect of other halogen atoms and cyano group at the para position of the phenyl ring and the effect of an extra chlorine atom in the p-chlorophenyl group habe beep studied. The work has been further extended in which the isopropyl group in N^1-2 ;4-dichlorophenyl .N^5- isopropyl-biguanide has been replaced by a number of different alkyl groups.

88. Studies in Antimalarials—Part III. Synthesis of Some 5-substituted Guanidines of 2-chloro-7-methoxy Acridine.

P. C. GUHA *and* J. R. GUHA, Bangalore.

Atebrin, though claimed to have been superseded by the biguanide derivative Paludrine as an antimalarial, is 2-chloro-5-diethylamino-isopentylamino-7-methoxy acridine. It was considered desirable to prepare a series of 2-chloro-7-methoxy acridine derivatives with guanidino, biguanidino and amidine grouping inserted in position 5. 2-Chloro-5-amino-7-methoxy acridine by the action of thiourea gave the corresponding 5-thiocarbamido derivative. With the object of preparing the corresponding guanidine derivative, the ethyl-thiol compound of the thiocarbamide was treated with ammonia and amines without success.

The second method tried has been successful. It consists in treating the 2-chloro-5-amino-7-methoxy acridine with cyanogen bromide resulting in the formation of the 5-cyanamido acridine compound, m.p. 231°C (I), which on treatment with aniline, *o*- and p-toluidines, *o*- and *p*- anisidines and *p*-chloroaniline have given the corresponding R- substituted guanidine derivatives of 2-chloro-7-methoxy acridine, melting respectively at (i) R=Ph m.p. 178°., (ii)R=*o*-$CH_3C_6H_4$ m.p. 204°.,(iii) R=*p*-CH_3. C_6H_4 m.p. 180° (iv) R=*o*-$OCH_3.C_6H_4$., m.p. 188°., (v) R=*p*.$OCH_3.C_6H_4$ m.p. 198°., (vi) R=p-Cl.C_6H_4 m.p.220°.

89. Studies in Antimalarials—Part: IV. Some Quinoline Substituted-biguanides.

P. R. GUPTA *and* P. C. GUHA, Bangalore.

In the field of synthetic antimalarials, the quinoline compounds are considerd to exert effective parasiticidal activity, With a view to studying the antimalarial activity of quinolyl-biguanides, some new N^1-(8-quinolyl)-N^5-aryl-biguanides and some N^1-(8-chloro-5-quinolyl)-N^5-substituted-biguanides have been prepared.

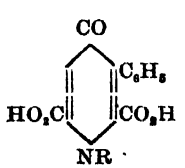
By the action of 8-amino-quinoline hydrochloride on the corresponding aryl-cyno-gaunidines, eight biguanides with the following substituents have been prepared:- (i) N^1-(8-quinolyl)-N^5-phenyl-, (m.p. 190°C.); (ii) p-tolyl-, (m.p. 190-91); (iii) p-anisyl-, (m.p. 179°C.); (iv) p-NO_2-phenyl-, (m.p. 188-89°C.); (v) p-AcNH-phenyl-, (m.p. 250°C); (vi) p-Cl-phenyl-, (mp. 191-92°C.); (vii) p-Br-phenyl-, (m.p. 204-205°C.) and (viii) p-I-phenyl-, (m.p. 239°C.)

In the second seires, 8-chloro-5-quinolyl-amine hydrochloride was made to react with the appropriate cyanoguanidines giving the following substituted biguanides :- (i) N^1-(8-chloro-5-quinolyl)-N^5-unsubstituted-, (m.p. 213°C.); (ii) phenyl-, (m.p. 198°C.); (iii) p-tolyl-, (m.p. 170-171°C.); (iv) p-anisyl-, (m.p. 210°C.); (v) p-AcNH-Phenyl-, (m.p. 194-96°C.); (vi) p-anilyl-, (m.p. 165-66); (vii) p-NO_2-phenyl-, (m.p. 207°C); (viii) p. Cl-phenyl-, (m.p. 214°C.); (ix) p-Br-phenyl-, (m.p. 210-11); (x) p-I-phenyl-, (m.p. 152°c.) All of the compounds decompose at their melting points.

90. Studies in Antimalarials—Part V. N-Substituted-phenyl Pyridines.

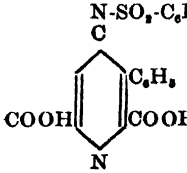
L. NEELAKANTAN, B. H. IYER *and* P. C. GUHA, Bangalore.

Quinine, plasmoquin and atebrin, the well-known antimalarial drugs can be regarded as benzo- or dibenzo- substituted pyridine derivatives. With a view to studying the antimalarial activity of simpler pyridine derivatives, phenyl pyridine derivatives of types (A), (B) and (C) have been prepared by reacting 3-phenyl-1:4-pyrone-2:6-dicarboxylic acid with primary amines, sulphonamides and biguanides, respectively.

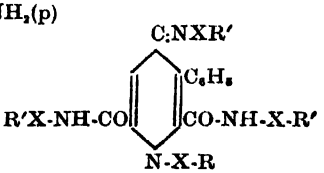


(A)

R= -CH_3; C_2H_5; C_6H_{11}; C_6H_5; Cl.C_6H_4; MeO.C_6H_4; N^4-sulphathiazole; N^4-sulphapyridine; N^4-sulphadiazine, etc.



(B)



(C)

X= -C(=NH)NH-C(=NH)-NH-C_6H_4

R'= H; Cl; MeO; Me; NO_2

91. The Optical Rotatory Powers of Quinine Salts.

SUDHAMOY MUKHERJEE, Calcutta.

A study has been made on the dependence of the optical rotation of quinine salts on various factors including concentration, temperature and the presence of various cations and anions. The molecular rotation of different quinine salts is found to vary in the order: bihydrochloride > bisulphate > tartrate (in N/20HCl) > hydrochloride (neutral). It also increases with dilution. Increase of temperature causes a lowering of the rotation.

The molecular rotation of quinine hydrochloride increases with the addition of hydrochloric acid and reaches maximum value when the proportion of acid is 1.25 equivalents corresponding to one molecule of quinine hydrochloride. On adding further quantities of hydrochloric acid the rotation gradually decreases. A similar decrease takes place if sodium chloride is added after the maximum rotation has been reached.

The addition of sodium chloride to neutral quinine hydrochloride solution causes a decrease of the molecular rotation. Sulphuric acid, however, increases the rotation in the same manner as hydrochloric acid.

The addition of different electrolytes, in 2 normal concentration, lowers the molecular rotation of quinine sulphate solution (in N/10 H_2SO_4) in the following order: HCl, NaCl, $MgCl_2$ > $AlCl_3$ > $NaNo_3$ > $(COOH)_2$ > Na_2SO_4 > H_3Po_4 > CH_3. CO_2Na > H_2SO_4 > citric acid. Acetic acid increases the rotation slightly. A similar marked depressing effect of hydrochloric acid and sodium chloride is also noticed on quinine tartrate solution (in N/20 HCl).

The significance of the results has been discussed.

92. Studies on Sulphonamides and Analogous Compounds:—Part III.

U. P. BASU, Calcutta.

Sulphanilyl benzamide, sulphacetamide, sulphadiazine and sulphamerazine have been condensed with formalin as well as hexamine to afford the corresponding 4-hydroxy methyl derivatives of the sulpha drugs. These compounds are readily soluble in alkali, and liberate formaldehyde on warming. They remain unchanged under the influence of dilute hydrochloric acid (0.36%) even for a period of three hours.

As, for exerting the chemotherapeutic action, a sulpha drug must be present in the anionic form at the site of infection, these compounds might be expected to be effective against intestinal infections. As a matter of fact the hydroxymethyl amino benzene sulphon benzamide is being reported to exert even a bactericidal action again *v. cholerae* in very small concentration *in vitro*.

93. On the Chemistry of "6257"- A Sulpha Compound Active against V. Cholerae.

U. P. BASU, Calcutta.

Recently a compound of the empirical formula $C_{21}H_{22}O_6N_6S_4$ has been found (Bhatnagar, *Brit. Med. Jour.* 1948, *i*, 719) to be effective against human Cholera infection. It was obtained by the interaction of 2 molecules of sulphathiazole with 3 molecules of formalin in the laboratories of Ciba at Switzerland, but no constitution has been ascribed to the compound.

Working in this direction it is being noticed that the coumpound may also be obtained by reacting sdlphathiazole with hexamin. From a study of its characteristics and from other allied reactions it seems to be a compound where both the mobile hydrogen atoms in sulphathiazole have been replaced by interaction with formaldehyde. As the parent compound exists in two forms (*cf.* Shepherd, *Jour. Amer. Chem. Soc.*, 1942, *64*, 2532), the present condensation product may be methylene N, N'-*bis*-(4-hydroxymethyl-2-sulphanilamido-thiazole), or, methylene-3, 3'-*bis*- (4-hydroxyymethyl-2-sulphanilimido -2, 3-dihydrothiazole), or, both. But the non-solubility of the compound suggests the latter structure.

94. Hydrolysis of Sulphonamides by Sulphuric Acid.

D. D. KARVE, K. K. DOLE, *and* R. D. SONATAKKE, Poona.

Hydrolysis of the aromatic sulphonamides has been carried out at different temperatures and with different concentrations of the catalysing acid. The sulphonamides investigated include :—

1) Benzene Sulphonamide
2) p-amino benzene sulphonamide
3) p-toluene sulphonamide.

Out of these, p-amino benzene sulphonamide was investigated in detail. Its study showed that at moderately high temperatures (120° to 150°C) the hydrolysis proceeded at a measureable rate and followed unimolecular law fairly accurately. An increase in the concentration of the catalyser (20 N to 30 N), and an increase in the temperature of the reaction (120° to 150°C) favours the reaction with a temperature co-efficient of about 2.5.

The hydrolysis of p-toluene sulphonamide proceeded at a rate faster than that for p-amino-benzene sulphonamide. Benzene sulphonamide hydrolysed still faster. Thus the order of decreasing reactivity was found to be benzene sulphonamide, p-toluene-sulphonamide and p-amino-benzene-sulphonamide.

p-Carboxy benzene sulphonamide was not investigated since it was found to be insoluble in sulphuric acid.

Further work is in progress with the detailed investigation of p-amino benzene sulphonamide and p-toluene-sulphonamide at different temperatures and using different concentrations of the catalyser.

95. Condensation of 2:4:6-Trichloro-, 2:4:6:Tribromo- and 2:4:6-Tri-Iodo-3-Hydroxybenzaldehydes with Malonic Acid.

KANTILAL C. PANDYA *and* RAGHU NATH SINGH, Agra.

Lock and Bayer (1939) have shown that in Perkin's Reaction chlorine exerts a helpful influence to a certain extent. Pandya and Miss Pandya (1941) also pointed out that in the aldehyde-malonic acid condonsations, catalysed by pyridine, the presence of a chlorine atom, and even more, that of a bromine atom, on the aromatic ring of the aldehyde, has a most striking effect finishing up the reaction in some cases in only 1.5 hours with a quantitative yield. Iodine has also been found to have a similar effect.

m-Hydroxybenzaldehyde has been found, in these condensations, to give a quantitative yield of *m*-coumaric acid. When the aldehyde contains on the ring three chlorine or three bromine or three iodine atoms, a further increase in the yield is therefore impossible, but the acceleration in the speed of the reaction becomes obvious.

The three tri-halogenated aldehydes give a nearly theoretical yield of the dibasic acids, the 2: 4: 6-trihalogenated-3-hydroxybenzylidene-malonic acids. *m*-Hydroxy-benzaldehyde has only recently (1948) given in the hands of Pandya and Miss Rajani Bala Pandya about 25% of the *m*-hydroxybenzylidenemalonic acid, earlier workers not having succeeded in isolating it. When compared to this 25%, the almost theoretical yield from the three tri-halogenated aldehydes, is a great improvement. It appears that the halogen, particularly chlorine, gives greater stability to the dibasic acid.

96. Condensation of 4-Bromo- and 6-Iodo-3-Hydroxybenzaldehyde and of *m*-Hydroxybenzaldehyde with Malonic acid.

KANTILAL C. PANDYA *and* Miss RAJANI BALA K. PANDYA, Agra.

Pandya and Miss Rajani Bala Pandya and later Pandya and Raghu Nath Singh have shown the effect of the halogen in the aldehyde-malonic acid condensations. The present work also bears on it.

m-Hydroxybenzaldehye gave a quantitative yield of *m*-coumaric acid in the above condensation (Pandya and Vahidy, 1936). The same yield has now been obtained at water-bath temperature in the presence of pyridine acetate. By following Stuart's method for the first time *m*-hydroxybenzylidenemalonic acid, m.p. 150-151° has been isolated in 25% yield.

4-Bromo-3-hydroxybenzaldehyde gave both the acids, the 4-bromo-3-hydroxycinnamic and the 4-bromo-3-hydroxy-benzylidenemalonic acids, the former in about theoretical yield and the latter in about 42% yield.

6-Iodo-3-hydroxybenzaldehyde condensed very fast. Only 2.5 hours' heating was sufficient to give a 94% yield of the 6-iodo-3-hydroxycinnamic acid. The corresponding dibasic acid has not yet been obtained. The presence of iodine makes the aldehyde as well as the acid somewhat unstable at high temperatures.

97. Condensation of Aldehydes with Ethyl Acetoacetate in the Presence of Organic Bases.

DEVBRAT DUTT, SOMENDRA NATH GUPTA *and* KANTILAL C. PANDYA, Agra.

The condensation of aldehydes with acetoacetic ester in the presence of piperidine and other bases has been extensively studied by Knoevenagel almost half a century back. The powerful catalytic effect of 1/6th of a molecule of pyridine in malonic acid-aldehyde condensations has been pointed out by the work in this Laboratory since 1932. An attempt has been made to find out if the reactivity of the methylene group in acetoacetic ester is also similarly catalysed by pyridine. About nine different aldehydes have been condensed with this ester in the presence of piperidine *or* pyridine under different conditions of temperature, time and molecular proportions.

Pyridine has been found to be a successful condensing agent in this reaction also. Because it is a weaker base than piperidine, it has to be used in larger molecular proportion (6 molecules for one of aldehyde), and waterbath or similar temperatures can be used, and are necessary to quicken the condensation. It did not often form resin and generally gave the monoacetoacetate product in a very pure form. Conditions have been worked out to get the *bis*-acetoacetate by using piperidine in a few drops. The yields, when pyridine is used, are often good, though generally they are less than those obtained when piperidine is used. Some of the condensation-products are probably new. The reactivity of the methylene group is here—as in aldehyde-malonic acid condensations—very much affected by the other groups present in the aldehyde molecule.

98. Friedel-Crafts Reaction in Hydroxyquinolines.

V. M. THAKOR *and* R. C. SHAH, Bombay.

In continuation of the work already reported (Indian Science Congress Abstracts, 1947), Friedel-Crafts reactions have been carried out on 4-hydroxy-2-methylquinoline, when with acetic anhydride and acetyl chloride 4-hydroxy-2-methyl-3-acetylquinoline and with benzoyl chloride 4-hydroxy-2-methyl-3-benzoylquinoline were obtained. This is the first instance of Friedel-Crafts reaction in hydroxyquinolines with the hydroxy group in pyridine rings.

All attempts to carry out Friedel-Crafts reaction with 2-hydroxy-4-methylquinoline were unsuccessful showing the feeble reactivity of 3-position in 2-hydroxyquinoline derivatives. This was confirmed, as attempts to couple the quinoline with benzenediazonium chloride were also unsuccessful.

99. Azo Dyes from Diphenyl-p-aminobenzamidine.

K. R. BHARUCHA *and* R. C. SHAH, Bombay.

A number of azo dyes from diphenyl-*p*-aminobenzamidine—which is readily obtainable by the method of Shah (*J. Ind. Inst. Sc.*, 1924, **7**, 205) from anfline and carbon tetrachloride—have been prepared by coupling its diazonium chloride with phenol, salicylic acid, β-naphthol, β-naphthylamine and 2-hydroxy-3-naphthoic acid. With a view to obtain some Azoic or Ice colours, couplings were carried out with different Brenthols like Brenthol OT, Brenthol CT, Brenthol PA, Brenthol AS, Brenthol BN and Brenthol AT. Couplings have also been brought about with some naphthol- and naphthylamine-sulphonic acids including G acid, R acid, Schaffer's acid, Branner's acid and Naphthionic acid.

100. Some Reactions of Diphenyl-p-aminobenzamidine.

K. R. BHARUCHA *and* R. C. SHAH, Bombay.

Diphenyl-*p*-aminobenzamidine was diazotised and subjected to various reactions whereby the NH_2 group in benzamidine was replaced by different radicals such as Cl, Br, I, and OH giving rise to a number of derivatives of diphenylbenzamidine with substituents in the para position. These benzamidines have also been obtained from the corresponding *p*-chloro-, *p*-bromo-, and *p*-iodo-benzoic acids through their anilides by the method of Sidiki and Shah (*J. Univ.* Bombay, 1937, *6A*, 132). Diphenyl-*p*-cyanobenzamidine could not be obtained from diphenyl-*p* aminobenzamidine and was synthesised from *p*-cyanobenzoic acid through its anilide in the above manner. Sulphonation, bromination and nitration of the base have also been carried out but it was only in the case of sulphonation and nitration that pure products could be isolated.

101. Condensation of Benzanilide Imidochloride with Phenols : A new Synthesis of Hydroxybenzophenones.

(MISS) RAGINI PHADKE *and* R. C. SHAH, Bombay.

Benzanilide imidochloride has been condensed with resorcinol, phloroglucinol, α- and β-naphthols using anhydrous aluminium chloride as the condensing agent. The resulting products which are keto-anils have subsequently been hydrolysed to the corresponding hydroxy-benzophenones, and hydroxy-naphthyl-phenyl ketones. Resorcinol dimethyl ether has also been condensed with benzanilide imidochloride to give the corresponding keto-anil. This provides a new synthesis of hydroxybenzophenones. Work is in progress on similar condensations with phenol, anisole, resorcinol monomethyl ether and other phenols.

102. Substitution in the Orcinol Nucleus.

P. R. SARAIYA *and* R. C. SHAH, Bombay.

The Fries Transformation of the diacetate of methyl *o*-orsellinate under differen conditions gave methyl 2-acetyl-*o*-orsellinate and methyl 2:4-diacetyl-*o*-orsellinatet From the diacetate of ethyl *o*-orsellinate ethyl 2-acetyl-*o*-orsellinate, ethyl 2:4-diacetyl. -*o*-orsellinate, and 2:4-diacetyl-*o*-orsellinic acid were obtained in a similar manner.

With the exception of 2:4-diacetyl-*o*-orsellinic acid, the same compounds were also produced by the Friedel-Craft acetylation of methyl and ethyl *o*-orsellinates with acetyl chloride or acetic anhydride.

The Fries Transformation of the diacetates of methyl and ethyl *p*-orsellinates as well as the Friedel-Craft acetylation of methyl and ethyl *p*-orsellinates gave only 4-acetyl-*p*-orsellinic acid, which was decarboxylated to β-orcacetophenone by heating with copper-bronze and quinoline.

103. Substitution in Resorcinol Nucleus.

C. S. MODY *and* R. C. SHAH, Bombay.

It has been found that in case of orcinol, substitution takes place in γ-position in many cases, unlike resorcinol where γ-substitution is rare. No explanation is available so far for this anomalous behaviour of orcinol. In order to obtain some further data on the subject some reactions have been carried out on methyl ester of α-resorcylic acid or 5-carboxyresorcinol.

When Gattermann's reaction was carried out on methyl α-resorcylate, substitution took place in β-position and methyl 3:5-dihydroxy-2-formylbenzoate was obtained.

In Fries and Friedel-Crafts reaction on methyl α-resorcylate no pure product could be isolated.

Pechmann reaction on methyl α-resorcylate with acetoacetic ester in presence of sulphuric acid gave methyl 7-hydroxy-2-methyl-chromone-5-carboxylate, 7-hydroxy -2-methylchromone-5-carboxylic acid and methyl 5-hydroxy-4-methylcoumarin-7.

carboxylate. On Pechmann reaction with ∞-resorcylic acid, only 7-hydroxy-2-methylchromone-5-carboxylic acid was obtained. This is one of the rare cases where chromones are obtained in Pechmann condensation, using sulphuric acid as a condensing agent.

Methyl ∞-resorcylate when condensed with malic acid however, gave 7-hydroxycoumarin-5-carboxylic acid and little of its methyl ester.

104. Nuclear Benzylation of Polyhydroxy Ketones.

B. Z. MULLAJI *and* R. C. SHAH, Bombay.

Nuclear alkylation of hydroxy aromatic compounds has been studied by various workers (Herzing and Zeisel, *Monatsh*, 1888, 1889 & 1890; Perkin, *J. Chem. Soc.*, 1895; Robinson and Shah, *ibid.*, 1934; Shah and Samant, *Proc. Ind. Acad. Sci.*, 1938). But no work has been reported on nuclear benzylation of hydroxy aromatic compounds.

Nuclear benzylation of hydroxy ketones was carried out with benzyl chloride. It was found that resacetophenone, respropiophenone, resbutyrophenone and resbenzophenone are comparatively easily nuclearly benzylated giving 3-benzyl derivatives. The same ketonic derivatives have been obtained by the Hoesch reaction on 2-benzyl resorcinol with the corresponding nitrites. This is of interest since nuclear ethylation takes place with more difficulty than methylation, but even though the benzyl radical is a heavier one, benzylation is more facile.

105. Action of Chlorosulphonic Acid on Coumarins.

J. R. MERCHANT *and* R. C. SHAH, Bombay.

No work appears to have been done on the action of chlorosulphonic acid on coumarins. Action of chlorosulphonic acid has now been studied on simple coumarin and 6-nitrocoumarin under different conditions when coumarin-6-sulphonic acid, coumarin 3:6-disulphonic acid, 6-nitrocoumarin-3-sulphonic acid and their chlorides are obtained. The action of chlorosulphonic acid on a number of 7-hydroxycoumarin derivatives has been studied. The products have been found to be mono-, di-, or tri-sulphonic acids and sometimes the sulphonyl chlorides. The sulphonic acids are isolated as their sodium or barium salts and are characterised by the formation of derivatives with S-benzyl thiuronium hydrochloride. The constitution of the sulphonic acids and the sulphonyl chlorides obtained have been established.

The work is being extended in the 5-hydroxy-4-methylcoumarin series.

106. Action of Chlorosulphonic Acid on Chromones.

J. R. MERCHANT *and* R. C. SHAH, Bombay.

No work appears to have been done on the action of chlorosulphonic acid on chromones. The action of chlorosulphonic acid has now been studied on 7-hydroxy- and 5-hydroxy-2-methylchromones and their methyl ethers. The products which are sulphonic acids have been isolated in the form of their sodium or barium salts and are characterised by the formation of derivatives with S-benzyl thiuronium hydrochloride. The constitution of some of the sulphonic acids have been established.

107. Condensation of ∝ : ∝ : β-trichloro-*n*-butyraldehyde with Benzene and Naphthalene Derivatives.

(MISS) L. H. DALAL *and* R. C. SHAH, Bombay

In continuation of the work reported last year (Indian Science Congress Abstracts 1948, 35) ∝: ∝: β-trichloro-*n*-butyraldehyde has been condensed with phenol when the compound of the structure ∝: ∝-*bis*-(*p*-hydroxyphenyl)- β: β: γ-trichloro-*n*-butane was obtained. Similar compounds have been obtained in case of toluene and ∝- and β-chloronaphthalenes. Their structures have been proved by dehydrohalogenation and subsequent oxidation to their corresponding known benzophenones and dinaphthyl ketones.

The work on similar condensations with other derivatives is in progress.

108. Halogenation. Chlorination, Bromination, Iodination and Nitration of o-and p-Hydroxy diphenyls and their ethers.

P. S. VARMA, *and* B. C. LAL AGARWAL

By chlorination 3:5-dichloro-2-hydroxy diphenyl m.p. 256–258°, 3-chloro-4-hydroxy diphenyl, m.p. 75°, 5-chloro 2-methoxy diphenyl, m.p. 68°, 3:5-dichloro-2-methoxy diphenyl, m.p. 52°, 4-chloro-4-methoxy diphenyl, m.p. 92°; 3:4-dichloro-4-methoxy diphenyl, m.p. 42°; by bromination 5-bromo-2-methoxy diphenyl, b.p. 260–261°, 3:5-dibromo—methoxy diphenyl. 3-bromo-4-methoxy diphenyl m.p. 79°, 4-bromo-4-methoxy diphenyl, m.p. 144°; by iodination 3:5:4-triodo-4-hydroxy diphenyl, m.p. 102° and by nitration 5-nitro-4-methoxy diphenyl, m.p. 95–36°, 3-nitro-4-methoxy diphenyl, 3:4-dinitro 4-methoxy diphenyl, m.p. 171° have been prepared and their constitution established.

109. Halogenation. Part XLIII. Iodination.

P. S. VARMA, K. S. VENKAT RAMAN *and* U. N. NARAYAN RAO, Banaras.

o-Chloro-nitrobenzene, m-bromo-nitrobenzene, anisole, phenetole, 0-nitrophenetole, p-bromo-anisole and p-bromophenetole have been iodinated under different conditions by methods worked out in our Laboratory and the following compounds have been obtained :— 5 Bromo-2-iodo-1-nitrobenzene, 5-iodo-2-chloro-1-nitrobenzene, 2-nitro-4-iodophenetole, 2-iodo-4-nitrophenetole, 2-nitro-4-iodoanisole, 4-nitro-2-iodo anisole and iodo-nitro derivatives of p-bromoanisole and p-bromophenetole.

110. Synthesis of Some New Organo-metallic Compounds of Selenium.

P. S. VARMA, K. S. VENKAT RAMAN *and* P. V. G. KRISHNAMACHARYULU, Banaras.

Selenium oxy-chloride has been condensed with (1) dimethyl aniline ,(2) diethyl aniline, (3) methyl ethyl aniline, (4) methyl benzyl aniline, (5) ethyl benzyl aniline, (6) dibenzyl aniline, (7) dimethyl p-toluidine, (8) dimethyl α-naphthyl amine, (9) ethyl benzyl-o-toluidine and (10) methyl diphenyl amine and well-defined crystals of their condensation products have been obtained and their properties studied.

111. Synthesis of four Isomeric Methyl Derivatives of 7-chloro-7 : 12-dihydro- and 12-chloro-7 : 12-dihydro-benzo-phenarsazines and 2-benzoyl-10-chloro-5 : 10-dihydro-phenarsazine.

P. S. VARMA, K. S. VENKAT RAMAN *and* T. P. VISVANATHAN, Banaras.

o-Tolyl- α-naphthyl amine, o-tolyl- β-naphthyl amine, m-tolyl-α-naphthyl amine, m-tolyl- β-naphthyl amine and phenyl p-amino benzophenone have been condensed with arsenic trichloride dissolved in o-dichlorobenzene and the condensed products, four isomeric methyl derivatives and the benzyl derivative of benzophenarsazine so obtained have been oxidised to the corresponding arsenic acids and their ethoxy and phenoxy derivatives studied.

112. Studies in Sulphur, Selenium and Tellurium Compounds. Preparation and properties of Phenothionine, Phenoxselenine and Phenoxtellurine.

P. S. VARMA, K. S. VENKAT RAMAN *and* (MISS) INDU D. BOKIL, Banaras.

Phenoxthionine, m.p. 58°, phenoxselenine, m.p. 88°, phenoxtellurine, m.p. 79° have been prepared and their properties studied. Phenoxthionine yields an oxide m.p. 158–159° and a dioxide, m.p. 147–148° and does not form a dichloride, dibromide or diacetate. Phenoxselenine forms an oxide, a dihydroxide, a stable dichloride and an unstable acetate. Phenoxtellurine yields similar derivatives.

113. Mercuration of Amines.

P. S. VARMA, K. S. VENKT RAMAN *and* (MISS) INDU D. BOKIL, Banaras.

The mercury derivaties of methyl benzyl aniline and methyl ethyl aniline have been prepared either by the action of mercuric acetate in an alcoholic solution of the base or by dissolving yellow mercuric oxide in an aqueous solution of the acetate of the amine. The mercuric acetate derivative so obtained has been converted into the hydroxide, the chloride, bromide, iodide and nitrate in almost quantitative yields. The diaryl mercury derivatives have also been obtained.

114. Crystalline Components of the Bark of Prunus Puddum.

D. CHAKRAVARTI, Calcutta.

The glucoside sakuranin (m.p. 213–214°) has been isolated from the immature bark of *Prunus Puddum*, while not a trace of the previously described components of the mature bark *e.g.* Puddumetin, Prunusetin, Sakuranetin have been obtained. The glucoside on hydrolysis furnishes the flavanone Sakuranetin ($C_6H_{11}O_5$) m.p. 150–151°, methyl ether, m.p. 116–117°, oxime, m.p. 201–203°.

115. A New Process for the Manufacture of Ephedrine Hydrochloride from the Ephedras.

S. K. SAHA, Calcutta.

A direct and economic method has been developed for the extraction of Ephedrine Hydrochloride from the ephedras. Finely powdered drug is thoroughly mixed with straw, lime and water and extracted with solvent benzol in a specially designed apparatus in which the solvent circulates in continuous cycle first through the drug, then into dilute hydrochloric acid and then through a reservoir into drug again until extraction is complete. Ephedrine hydrochloride is directly obtained by concentrating the acid solution. The yield is almost theoretical.

116. Dipole Moment of Fatty Acids.

S. K. K. JATKAR *and* (MISS) S. B. KULKARNI, Bangalore.

In continuation of the previous work on the dipole moment of fatty acids like capric, stearic etc., the dipole moments of the homologous series of fatty acids in pure liquid state as well as in different solvents have been calculated by applying the new relationship. The results show that in liquid state the acids are associated to dimers, which dissociate into monomers at higher temperatures. The moments calculated from the data in solutions like benzene, indicates that the moments increase with concentration. Hence the planar model for dimer proposed by Pauling and Brockway does not hold good. In addition to the Skew (boat) model proposed by Paranjpe for the dimer, one more chair model, which has zero moment, has been proposed by the present authors. The increase of dipole moment of acids in benzene with concentration has been explained as due to the change in the percentage mixture of boat and chair form of the dimers, the boat form having a moment of 1.4 and the chair form a zero moment. *The increase* in dipole moment of the pure acids at higher temperature is due to the dissociation of the dimers. The apparent moment calculated from dioxane and ether also indicates that in these solvents the acids are partially associated, the moments at zero concentration corresponding to the free rotation value of the monomer.

117. Dipole Moments of Diketene, Benzoic Anhydride & Benzoyl Peroxide.

S. K. K. JATKAR *and* R. J. SUJIR, Bangalore.

The new equation has been employed to calculatee the dipole moments of diketene, benzoic anhydride and benzoyl peroxide. The results are interpreted on the basis of component law.

118. Side Chain Chlorination of Aromatic Copmpounds in the Vapour Phase—Part II.

G. V. Asolkar, Nagpur.

In continuation of author's previous work (*Proc. Ind. Sci. Cong.* 1945 and *J. Ind. Chem. Soc.* Vol. XXIII, *No. 2* 1946, 47–52) it was deemed necessary to investigate the chlorinations of some aromatic nitro compounds in the vapour phase. It was previously pointed out (*loc. cit*) that the chlorination of the meta and para nitrotoluenes are negative in the vapour phase inspite of the prolonged chlorination.

By modifying the experimental condition *viz.*,using sulphur (*cf.* Haenssermann and Beck, *Ber.* 1892, *25*, 2445---Chlorination in the liquid state), and using ultraviolet light it is found that the vapour phase chlorination of the nitrotoluenes (-m and-p) does take place, The yields of the side chain products are poor, and other nuclear substitution products are produced rendering the separation of the products difficult. The results are still negative for o-nitrotoluene, even under these modified conditions. The vapour phase chlorinations of such nitro compounds as nitrobenzene, o, m, p-nitrobenzaldehydes are in progress.

The vapour phase chlorinations of some essential oils like the Palm Rosa oil (Rusa Grass oil), oil of Calamars, Citronellol, Geraniol have also been carried out.

119. Chalkones from Respropiophenone and its Monomethyl Ether.

P. B. Mahajani *and* Suresh Sethna, Bombay.

Respropiophenone and its monomethyl ether have been condensed with benzaldehyde and the products obtained shown to be 2:4 dihydroxyphenyl-α-methylstyryl ketone and 2-hydroxy-4-methoxyphenyl-α-methyl styryl ketone respectively. On methylation both gave the same dimethyl ether.

Similar condensation of respropiophenone and its monomethyl ether with *p*-anisaldehyde gave 2: 4-dihydroxy phenyl-α-methyl-4′-methoxystyryl ketone and 2-hydroxy-4:4′-dimethoxyphenyl-α-methylstyryl ketone respectively. On methylation both gave the same trimethyl ether.

The hydroxy chalkones have been converted into the corresponding flavanones by the action of dilute alkali and into the corresponding flavones by heating with selenium dioxide.

120. Bromination of 6–Hydroxy–4–methylcoumarin and its Methyl Ether.

V. J. Dalvi *and* Suresh Sethna, Bombay.

6-Hydroxy-4-methylcoumarin has been brominated with one molecule, two molecules, and excess of bromine. The products obtained have been methylated and the methyl ethers thus obtained have been compared with the products obtained by brominating 6-methoxy-4-methylcoumarin with one molecule, two molecules and excess of bromine. The bromo derivatives from the methyl ether on hydrolysis with boiling alkali have yielded coumarilic acid derivatives.

121. Organic Fungicides I: Synthesis of Dibromacetamides.

A. B. Sen *and* K. C. Joshi, Lucknow.

The present work has been undertaken to study the modifications in fungicidal activity by increasing the number of halogen atoms. Six new dibromacetamides have been prepared preliminary to evaluation of their fungicidal activity.

The starting material, dibromacetic acid, has been obtained by the decarboxylation of dibromomalonic acid. The dibromacetic acid has been converted into dibromacetyl chloride by the action of thionyl chloride and the dibromacetamides obtained by the action of different amines on the dibromacetyl chloride in ether medium.

The following new compounds have been obtained.

	Name of Compound	m.p.
1.	N-methyl-dibromacetamide	122°C
2.	N-ethyl-dibromacetamide	81°C
3.	N-*n* butyl-dibromacetamide	76°C
4.	N-diethyl-dibromacetamide	212°C
5.	N-dibromacetanilide	138°C
6.	N-dibromacetyl-phenyl-hydrazine	Does not melt.

122. Studies in the Fries Rearrangement—Part IV.

A. B. SEN *and* V. S. MISRA.

The Fries Rearrangement has been extended to several esters of Sorbic acid. The following four esters were prepared which rearranged themselves into the corresponding ortho hydroxyketones, which were characterised as usual through their 2:4-dinitrophenylhydrazones:

Esters :

		b.p.°C/mm.
1.	Phenyl ester	141/2
2.	o-cresyl ester	143/4
3.	m-cresyl ester	180/17
4.	p-cresyl ester	m.p.73-74°C

Ketones :

1.	2′-hydroxyphenyl-Δ^{3}-Δ^{4}-hexadiene-one-1	83/3
2.	2′-hydroxy-6′-methylphenyl-Δ^{2}-Δ^{4}-hexadiene-one-1	103/1
3.	2′-hydroxy-3′-methylphenyl-Δ^{2}-Δ^{4}-hexadinene-one-1	122/17
4.	2′-hydroxy-4′-methylphenyl-Δ^{2}-Δ^{4}-hexadiene-one-1	150/10

123. Action of Phosphorous Pentachloride on Grignard Complexes.

A. B. SEN *and* G. S. SIDHU, Lucknow.

Aldehydes and ketones react with Grignard reagents to form complexes which on hydrolysis give alcohols. If halogen compounds are required, it is the usual practice to replace the hydroxy group in these alcohols by the use of some suitable reagent like phosphorous halides or thionyl chloride. The present authors have devised a method which saves one step in the preparation of such halogen compounds. The Grignard complex with the carbonyl compound instead of being hydrolysed to the alcohol is directly reacted with phosphorous pentachloride in dry ethereal suspension. After a few hours refluxing the complex is decomposed in the usual manner by just sufficient ice-cold dilute HCl and yields the halogen compound directly.

Diphenyl-chlormethane has thus been obtained from benzaldehyde, phenyl magnesium bromide and PCl_3, and 1-chloro-1, 1-diphenylethane (b.p.115-6/2mm) from phenyl magnesium bromide, acetophenone and PCl_5.

124. Quinazoline Derivatives—Part I.

A. B. SEN *and* G. S. SIDHU, Lucknow.

Very few quinazolol derivatives are described in literature. The present authors were interested in such compounds with a view to study the effect of the quinazoline ring on analgesic activity and have synthesised the following 4-quinazolols by the action of different Grignard reagents on 2-methyl-3-phenyl-4-quinazolone:-

I 2-methyl-3, 4-diphenyl-4-quinazolol

II 2-methyl-3-phenyl-4-*n*-propyl-4-quinazolol

III 2-methyl-3-phenyl-4-*n*-butyl-4-quinazolol

125. Synthesis of Substituted Dinitro Phenylketones and Phenylacetic Acids—Part III.

A. B. SEN *and* P. M. BHARGAVA, Lucknow.

2:4-Dinitro 6-iodophenylacetone, m.p. 110°, and 2:4-dinitro 6-iodophenylacetic acid (which does not melt, but decomposes on strong heating) have been prepared by the ketonic and acid hydrolysis respectively, of 2:4-dinitro 6-iodophenylacetoacetic ester, m.p. 74°, which has been obtained by the condensation of monosodium derivative of acetoacetic ester with 1-chloro 2:4-dinitro 6-iodobenzene. The ketone yields a phenylhydrazone, m.p. 74°, and an *oxime*, m.p. 75°. 2-Methyl 3-ethylcarboxy 5-iodo 7-aminoindole, m.p. 135°, has been obtained by the reduction of the above mentioned ester with iron powder and water.

126. Synthesis of Substituted Dinitro Phenylketones and Phenylacetic Acids—Part IV.

A. B. SEN *and* P. M. BHARGAVA, Lucknow.

2:4-Dinitro 6-chlorophenylacetoacetic ester, m.p. 64°, has been obtained by the condensation of 1:6-dichloro 2:4-dinitrobenzene with sodium derivative of acetoacetic ester. Ketonic and acid hydrolysis respectively, of the dinitrochlorophenylacetoacetic ester, results in the formation of 2:4-dinitro 6-chlorophenyl acetone, m.p. 99°, and 2:4-dinitro 6-chlorophenylacetic acid, which does not melt. The ketone a gives a *phenylhydrazone* m.p. 120°, and an *oxime*, m.p. 95°. The reduction of the above mentioned ester yields 2-methyl 3-ethylcarboxy 5-chloro 7-aminoindole, m.p. 126-27°.

127. Synthesis of Substituted Dinitro Phenylketones and Phenylacetic Acids—Part V.

A. B. SEN *and* P. M. BHARGAVA, Lucknow.

Condensation of sodium derivatives of acetoacetic and malonic esters with 1:3-dinitro 2:5-dichlorobenzene yields 2:6-dinitro 4-chlorophenylacetoacetic ester (I), m.p. 81°, and 2:6- dinitro 4-chlorophenylmalonic ester, m.p.85°, respectively. The ketonic and acid hydrolysis respectively of (I) results in the formation of 2:6-dinitro 4-chlorophenyl acetone, m.p.122-23°, and 2:6-dintro 4-chlorophenylacetic acid, which dose not melt. The ketone gives a *phenylhydrazone*, m.p. 117-18°, and an *oxime*, m.p.111°. 2-Methyl-3-ethylcarboxy-5-amino-7-chloroindole (m.p. 217°) has been obtained by the reduction of (I) by iron powder and water.

128. Synthesis of substituted Dinitro Phenylketones and Phenylacetic Acids—Part VI.

A. B. SEN *and* P. M. BHARGAVA, Lucknow.

The following new compounds have been obtained in very good yields:-

2:6-dinitro 4-iodophenylacetoacetic ester, m.p. 113-14°-by condensation of 1-cholro 4-iodo 2:6-dinitrobenzene with sodium derivative of acetoacetic ester,

2:6-dinitro 4-iodophenylacetone, m.p. 138-39°-by ketonic hydrolysis of the above mentioned estor; gives a phenylhydrazone,m.p. 140-142°,

2:6-dinitro 4-iodophenylacetic acid (which does not melt)-by acid hydrolysis of the ester mentioned above and,

2-methyl 3-ethylcarboxy 5-amino 7-iodoindole, m.p. 194-95°-by reduction of 2:6-dintro 4-iodophenylacetoacetic ester by iron powder and water.

129. Insecticidal Properties of Hexachlorocyclohexanes, DDT and Related Compounds.

S. K. Kr. JATKAR *and* (MISS) S. B. KULKARNI, Bangalore.

The law of unimolecular reaction $K=\frac{2.3}{t}\log\frac{100}{100-x}$ is employed to calculate

the mortality coefficients of the various insecticides like hexachlorocyclohexane, DDT etc., from the data on the percentage mortality (x) of the insects killed in certain time (t) and it has been shown that the mortality coefficient K is independent of concentration and time. The *r* isomer (m.p.112.5°C) is the most toxic compound being *240 times* as effective as *α and 840* times *as effective as* δ isomer towards mosquito larvas. Of the DDT isomers p, p'DDT is 7 to 10 times as toxic as m,p'-and o,p'-isomers. The compound TDE possesses equal toxicity as p,p' DDT. Comparison of the toxicity of Gammexane, DDT and cuprous cyanide to mosquito larvae of yellow fever, shows that Gammexane is 1.5 times as effective as p,p'DDT, cuprous cyanide being nearly twice as effective as *r* isomer in dilute solutions. The correlation between the electric momonts and the mortality coefficient, indicates that in hexachlorocyclohexane isomers the logarithm of the mortality coefficient is directly proportional to the moment which is the other way round in DDT isomers.

130. Hydrolysis of Amides by Mineral Acids.

V. V. WAKADE, G. G. MUJUMDAR *and* D. D. KARVE, Poona.

The hydrolysis of acetamide has been investigated at 50°C in three different solvents (water, ethyl alchol and acetic acid) using different concentrations of sulphuric acid as the catalyser.

The results clearly show that the tendency of attaining the maximum velocity of hydrolysis at some optimum concentration of the catalyser is common to all the three solvents investigated.

Previous investigators have observed that the optimum concentration of the catalyser for the best hydrolysis of the amide depends upon the nature of the amide and also upon the catalysing acid. The present investigation clearly shows that the optimum concentration of the same catalyser is dependent on the solvent also.

The rate of hydrolysis changes in the order

Water > Alcohol > Acetic acid.

The investigation of the hydrolysis of o-,m-and p-substituted benzamides and also the hydrolysis of acetonitrile under different conditions is in progress.

131. Direct Replacement of (OMgBr) Group by Halogen in the Grignard Complex.

A. B. SEN *and* M. P. UPADHYAYA, Lucknow.

An attempt was made to directly replace the (OMgBr) group in the Grignard complex by halogens. It has been found that partial replacement takes place with fuming and alcoholic hydrochloric acid, hydrobromic acid, sulphuryl chloride and phosphorus trichloride.

The Grignard reagent prepared in the usual way was treated with a ketone and the halogenating agent directly added to the ethereal solution. The mixture was extracted with ether, ether removed and the chloro or bromo compounds separated by fractional distillation under reduced pressure. The compounds prepared were phenyl-methyl-propyl-chloromethane, cyclohexyl--propyl-bromomethane and dimethyl-phenyl-chloromethane.

132. Formylation of methyl–m–hydroxy and p–hydroxy benzoates with hexamethylene tetramine.

(MRS.) RADHA PANT, Allahabad.

Duff and Bills (J. 1932, 1987) successfully formylated salicylic acid by heating it with hexamethylene tetramine but when they treated meta-and para-hydroxy benzoic acids under the same conditions, complex amorphous products were obtained. Desai and Radha (Proc. Ind. Acad. Sci. 1940, XI A, 422) and Shah, Radha and Desai (Proc. Ind. Acad. Sci. Vol. XXIII, 1946)found that the methyl esters of various phenolic acids could be formylated easily by this method- Methyl esters of *m*-and *p*-hydroxy-benzoic acids have therefore been subjected to the action of hexamethylene tetramine and the formyl esters obtained. The phenyl hydrazones and other derivatives of these esters have been prepared. The consitutions of these formyl esters are being studied.

133. Determination of Unsaturation in Oils and Soaps by Means of Hypochlorous Acid.

S. K. Basu *and* M. Goswami.

In the previous paper on the subject (Analyst, 1934,59, 533; J. Indian Chem. Soc. 1934, 11, 905) it had been shown by one of us the feasibility of determination of unsaturation in oils with hypochlorous acid and practical advantages over the prevalent methods e.g. Wiji, Hanus. There were some practical difficulties connected with the use of the said acid and the object of the paper has been to remove those so that it can be very easily adapted in technical practice. A further object has been to apply the method directly to determine the unsaturation in soaps without separating the acids-which method always gives a low result. A still further object has been to apply the method directly to oils without previous saponificaton. That sulphuric acid in the method (loc. cit) which introduces some complication can be conveniently replaced has been also investigated. Further instead of saponifying the oil which was the first step before the application of hypochlorous acid in the previous process, it was seen that acetic acid solution of the oil can directly be employed to react with hypochlorous acid and the results obtained have been found to be correct. Different oils, non-drying, drying and semi-drying and different kinds of soaps have been examined by this method.

134. Synthesis of Para-Amidinophenylarsenoxide and its Derivatives.

B. Pathak *and* T. N. Ghosh, Calcutta.

Although filarial infections are widely distributed in the tropics, no potent and dependable filaricide has yet been discovered. Recently, promising results in the chemotherapy of filariasis have been obtained with some phenylarsenoxide derivatives by Otto and Maren (*Science*, 1947, 106, 105). These observations and also the fact that various amidine derivatives have recently been found to possess pronounced parasiticidal property have now stimulated the synthesis of p-amidinophenylarsenoxide from *p*-cyanophenylarsenoxide. The latter compound, which has been obtained by reduction of the sodium salt of *p*-cyanophenylarsonic acid(Linsker and Bogert, *J. Amer. Chem. Soc.*, 1933,66, 932) with sodium bisulphite in aqueous solution, has been easily converted into the corresponding amidino derivative. Both these cyano-and amidino-phenyl arsenoxide exist in hydrated forms. This amidino derivative has been condensed with ethyl acetoacetate to give the corresponding pyrimidine derivative.

135. Attempts to Synthesise 5 : 5–Diphenyl–3–phenylhydantoin.

T. N. Ghosh, Calcutta.

In view of the recent observation by Aird (*Chem. & Eng. News*, 1947) that 5-phenyl 5-ethyl-3-methyl-hydantoin is somewhat superior to 5:5-diphenylhydantoin in the treatment of epileptic conditions, it has been considered desirable to synthesise 5:5-diphenyl-3-phenyl-hydantoin(I), so that its toxicity and activity can be compared with those of the above drugs. With this idea in view, benzil has now been allowed to react with mono-phenyl-urea in presence of alkali, when a mixture of phenyl-carbamido-diphenylacetic acid (II) and 2-phenylamino-4:4-diphenyl-5-keto-4:5:dihydro-oxazole (III) has been obtained. The compound (III), which is readily hydrolysed by alkali to (II), has been proved to be identical with the compound obtained by Eberly and Dains (*J. Amer. Chem. Soc.*, 1936, 58 2546) by fusing mono-phenyl-urea with benzilic acid. Eberly and Dains, however, assigned to this compound the structure (I), which now appears to be untenable in view of the detailed study of its properties.

The action of 20% alkali on (II) furnished a mixture of 1-phenyl-3-diphenyl-methyl urea (IV) and a compound which is tentatively assigned the structure, 3:3:6:6-tetraphenyl-2:5-diketopiperazine (V).

136. Chemical Examination of the Fruits of Pistacia Integerrima. Isolation of Two Crystalline Products.

Prithwi Nath Bhargava, Banaras.

The fruits on steam distillation have yielded an essential oil to the extent of 0.9% of the crude drug and from the residual fruits, a white crystalline product m.p. 172

has been isolated in beautiful silky needles in an yield of 0.23%and another white crystalline product in silky needles m.p.110° in an yield of 0.35%. The first has been provisionally named Pistacin and the second as Pistacinin. Both these crystalline products are soluble in chloroform and pyridine, sparingly soluble in benzene, methyl alcohol and ethyl alcohol but insoluble in water. Both of these are extremely resistant to alkalies and acids. Studies on their constitution are in progress.

137. Studies in the Thiazole Series.—Part I–Synthesis of 2–Imino–4–keto –tetrahydrothiazole and its derivatives with aryl and alkyl substituents in positions 2 and 3.

PRITHWI NATH BHARGAVA, Banaras.

2-Imino-4-keto-tetrahydrothiazole, m.p. 200° has been synthesized by condensing formamidinethiolacetic acid, m.p. 234° obtained by the action of monochloroacetic acid on thiocarbamide, with glacial acetic acid.

Similarly 2-phenylimino-3-phenyl-4-keto-tetrahydrothiazole, m.p.176°; 2-*o*-tolylimino-3-*o*-tolyl-4-keto-tetrahydro-thiazole, m.p.155°; 2-p-tolylimino-3-p-tolyl-4-keto-tetrahydro thiazole, m.p.127°; 2-α-naphthylimino-3-α-naphthyl-4-keto- tetrahydrothiazole, m.p.172°; 2-β-naphthylimino-3-β-naphthyl- 4-keto-tetrahydrothiazole, m.p. 165° (decomp.); 2-*p*-anisylimino-3-*p*-anisyl-4-keto-tetrahydrothiazole, m.p.105° and 2-*p*-phenetylimino-3-*p*-phenetyl-4-keto- tetrahydrothiazole, m.p. 101°, have been synthesized by condensation of the corresponding diarylthiocarbamides with monochloroacetic acid in the presence of freshly fused and powdered sodium acetate using absolute alcohol as the solvent.

138. The Essential Oil of Zanthoxylon Rhetsa.

PRITHWI NATH BHARGAVA, Banaras.

From the carpels of Zanthoxylon rhetsa, the essential oil has been obtained to the extent of 0.5% by steam distillation. Some important characteristics of the oil are as follows :—

Colour	Light brown
Sp. gravity (30°C)	0.8610
Refractive index (30°C)	1.4609
Specific rotation $(\alpha)_D 30°$	–32.5°
Sap. value	2.73.
Acetyl value	39.07.
Acid value	6.03.

Detailed investigations regarding the active constituents of the fractions of the oil are in progress.

139. Dipole Moments of Aliphatic and Aromatic Alcohols.

S. K. K. JATKAR, R. J. SUJIR *and* B. R. Y. IYENGAR, Bangalore.

Assuming the fractional additivity law of polarisation to hold good in the case of solutions, dipole moments of benzyl, α and β phenyl ethyl alcohols, tetrahydro β-naphthol, α and β indanol and hexahydroxy benzyl alcohol have been calculated using the new relationship. The characteristic temperature when taken into account will not only eliminate the apparent decrease of moment with temperature but will bring down the absolute value of the moment to the vapour value of 1.68, generally observed for alcohols.

Biochemistry.

140. Disturbance in the Balance of Hepatic Glycogenesis and Glycogenolysis by Intermediary fat Metabolites and its Restoration by Amellin.

M. C. NATH *and* C. H. CHAKRABORTY, Nagpur.

The injection of sodium salt of B-hydroxy butyric acid on rats caused acceleration in glycogenolysis as a result of which the glycogen content of liver and muscle got depleted. Depletion of glycogen in liver and muscle is found to be 83 and 84% respectively after a period of injection for 55 days.

Simultaneously the lactic acid content in liver and muscle increased, the increase being 188 and 173% respectively during the same period.

The important glands and organs such as the liver, heart, kidney and stomach were found to be affected, a particular feature being a white tumorous growth in the liver.

Loss of weight was also marked in almost all the animals after the 3rd week.

Administration of amellin checked the depletion of glycogen in liver and muscle and also prevented the accumulation of lactic acid in the above organs, thus helping glycogenesis and checking glycogenolysis.

Animals receiving amellin along with the ketone bodies looked more or less normal.

141. Influence of Ionic Environment on the Invertase Activity of Yeast.

M. M. BISWAS, Calcutta.

Invertase extract from dried Brewers' yeast powder has been allowed to react upon 20% saccharose solution as substrate and the pH of the reaction mixture adjusted to 4.5 with additions of $\frac{N}{10}$ hydrochloric, sulphuric, citric, oxalic and acetic acids.

Glucose formed by the volume of extract equivalent to 10 gms yeast powder has been estimated in presence of each of the acids and corresponding specific conductance values determined. Invertase activity has been found to maintain a constant level in presence of different anions at constant pH, though specific conductance values have changed. Experiments made with salts like KCl, $AlCl_3$, K_4FeCy_6, NaCl, Na_2SO_4, K_2SO_4, $CaCl_2$, $BaCl_2$ show a marked change in the invertase activity owing to varying valency of the constituent ions.

142. Effect of Ascorbic acid and other Substance on Ketolysis in Presence of Kidney Cortex.

M. C. NATH *and* (MISS) KUSUM LAUL, Nagpur.

1) Kidney cortex has been found to be more effective in bringing about the oxidation of Na-acetoacetate in vitro than the liver.

2) In presence of ascorbic acid in very small quantities (*i.e.* 1 mg. per c.c. of the solution) accelerates such ketolysis considerably.

143. Effect of Fat Metabolites on Blood Sugar and Lactic Acid Content in the Blood.

M. C. NATH *and* C. H. CHAKRABORTY, Nagpur.

1. Sodium aceto-acetate when injected in the normal animals (rabbits) in increasing doses beginning from 50 mg. per kg. caused hyperglycemia after an initial hypoglycemic stage.

2. When the dose was gradually increased to 150 mg. per kg. on the 8th week the average increase in blood sugar was found to be 73%.

3. The amount of lactic acid in the blood rose considerably after 8 weeks of such injection, there being observed an increase by 900%.

4. Some animals so treated showed typical diabetic sugar tolerance curves.

5. Enormous decrease in the ascorbic acid content of the plasma has been observed.

6. Loss of body weight was observed in all the animals.

144. p_H of the White and Yolk of Fertile Hen Egg during Incubation in Air, Carbon Dioxide and Liquid Paraffin.

M. A. WAJID, K. SUBBA RAO *and* B. SANJIVA RAO, Bangalore.

The variation in p_H is an important factor in the elucidation of the mechanism of many biochemical processes. The variation in p_H of the White and of the Yolk of fertile hen egg during incubation in air, carbon dioxide and liquid paraffin has been studied. After incubation over different intervals of time, the eggs were removed, the White and Yolk were carefully separated and the p_H determined by employing a glass electrode. In fresh egg, the White has a p_H of 7.85 and the Yolk 6.17. On continued incubation in air, the p_H of White increases to a maximum of 9.5 up to 36 hours and later decreases continuously. The p_H of the Yolk is practically constant up to the 2nd day and later increases slowly but continuously. The initial rise in p_H of the White is due to the loss of carbon dioxide and the subsequent fall to the metabolic processes resulting in the production of carbon dioxide. The small increase in p_H of the Yolk is probably due to the protein catabolism resulting in the formation of ammonia.

The p_H-Time curves of the White and Yolk of eggs incubated in carbon dioxide and liquid paraffin are practically coincident. The p_H of the White shows a small and continuous decrease and that of the Yolk a small and continuous increase. The conditions being anaerobic, the normal metabolic processes in the growing embryo are hindered. Consequently the changes in p_H are small.

145. Optical specificity of Protein Hydrolysate.

N. RAY, Calcutta.

Various proteins have been hydrolysed enzymatically and their rate of hydrolysis studied with respect to optical rotation. This is being found to be a linear function of the degree of hydrolysis, but the slopes differ with the nature of the protein.

146. Search for New Analgesics—Part III.

A. B. SEN *and* G. S. SIDHU, Lucknow.

In continuation of the work reported in Parts I & II of this paper (*Proc. Ind. Sci. Cong., Chem. Section*, 1947 & 1948), the synthesis of some more N-alkyl-substituted-γ-piperidones has been studied. Diethyl 1-ethyl-2, 6 diphenyl-4-piperidone 3, 5-dicarboxylate has been prepared by the method of Petrenko-Kritschenko (*Ber.*, 1909, 42, 3689) and has been reacted with several Grignard reagents. Phenyl magnesium bromide and ethyl magnesium iodide reacted with this piperidone to give the expected piperidols I & II respectively;

I diethyl 1-ethyl-2, 6 diphenyl-4-phenyl-4-piperidol 3, 5 dicarboxylate

II diethyl 1-ethyl-2, 6 diphenyl-4-ethyl-4-piperidol 3, 5-dicarboxylate

But *n*-propyl and *n*-butyl magnesium bromides yielded only plastic masses which could neither be crystallised nor distilled under high vacuum.

Industrial Chemistry.

147. Catalytic Oxidation of Ethylene.

S. K. K. JATKAR *and* S. V. S. RATNAM, Bangalore.

Dehydration of alcohol to yield ethylene has been carried out by passing hot vapours of alcohol over a bed of dehydrated potassium alum specially prepared for this purpose. This catalyst is found to be superior to alumina.

The oxidation of ethylene was carried out over vanadium catalysts with a view to partially oxidise ethylene to formaldehyde. In the initial stages the catalysts gave as much as 25% yield of mixtures of aldehydes for a single pass, and got poisoned due to the deposition of carbon on the catalysts.

148. Chlorination of Ethylene.

S. K. K. JATKAR *and* S. V. S. RATNAM, Bangalore.

Chlorination of ethylene was carried out by passing both ethylene and chlorine in ethylene-di-chloride in a glass vessel. It was found that at 25°C about 60% of the product formed was 1, 1, 1, trichloroethane or methylchloroform, 25% ethylenedichloride, and 15% 1, 1, 2, trichloroethane.

Using iron at room temperature in the form of turnings as a catalyst the products formed were 25% ethylene dichloride, 25% ethylidene chloride, 40% trichloroethane (1, 1, 1) and 10% 1, 1, 2, trichloroethane.

The chlorination over calcium chloride was carried out in the gas phase at 100°C. Using either an iron or glass apparatus it was found that about 80% of the products was ethylenedichloride.

149. Oxidation of Ethyl Alcohol under Silent Electric discharge Part I. Formation of Formaldehyde and other Oxidation Products.

R. H. SAHASRABUDHEY *and* S. M. DESHPANDE, Banaras.

Alcohol vapour-air mixtures obtained by bubbling air under varying pressures through ethyl alcohol at different temperatures, have been subjected to silent electric discharge in a Siemens' glass ozonsier at 7.8–8.4 kV and 500 cycles. The effluent gases were washed off the soluble products by passing them through a series of water wash-traps. Presence of formaldehyde, acetaldehyde, formic acid, and acetic acid was detected in the washings. For 3 to 5 cc of rectified spirit consumed the yield of formaldehyde as estimated by potassium cyanide method was found to range between 0.036 gms. to 0.047 gms, the total acidity of the solution corresponded with 0.06 gms. to 0.10 gms. of NaOH. Acetaldehyde, formic acid and acetic acid were not estimated quantitatively.

The results are of interest from the point of view of the possible utilization of low concentration fermentation alcohol for the production of raw materials for plastics and other allied industries.

Further investigation is in progress.

150. Rancidity of Mohua Oil.

V. N. GODBOLE *and* B. N. BANERJEE, Bangalore.

Commercial samples of Mohua oil contain considerable quantities of free fatty acids, 5 to 27%. This high f.f.a. lowers its market value and is the cause of rancidity even when made into soaps. When fresh seeds were collected, dried and the oil was extracted by us, the free acidity was only 0.4%. However, fresh seeds of Mohua have a moisture content as high as 40%. Therefore, high f.f.a. is due to fungus growth on Mohua seeds that are not properly dried or stored. Even dry seeds in presence of mois-

ture and summer temperature develop high acidity, 20% in a fortnight and 40% in a month. The iodine value goes down from 57 to 36. An analysis of the f.f.a and fresh oil, however, shows that this acidity rise is similar to those observed in the case of other oils and fats. Mohua oil has a high percentage of unsaponifiable matter, 2%. This fraction also undergoes changes on development of rancidity. The alcohol insoluble part of unsaponifiable matter is highly pro-oxidant compared to the alcohol soluble portion about 7 times in activity—at all dilution of even 0.03%.

The high percentage of unsaponifiable matter and its catalytic effect is responsible for the progressive development of f.f.a. in Mohua oil. If Mohua seeds be collected and dried and stored properly then the acidity can be held about 1% only.

151. Linoleic Acid Content and Detection of Adulteration of Ghee (Butter-Fat).

T. A. VENKATASUBRAMANIAN *and* B. N. BANERJEE. Bangalore.

The limits of natural variations due to breed, feed, season etc. of the Linoleic acid content of about 400 samples of ghee collected from all over India were estimated from the iodine and thiocyanogen values. It was found that in 90% of the cases the linoleic acid was not more than 2%, the remaining 10% giving figures between 2 and 2.5%.

Three samples of ghee of high, low and average iodine value were examined for their fatty acid composition by the ester fractionation method and the linoleic acid of the specimens were Wardha, 1.8%, Ahmedabad 1.1%, and Junagadh, 1.9% having an R.M. of 18.5, 30.1 and 36.0 respectively.

The samples containing more than 2% linoleic acid were rancid and had f.f.a. varying from 2 to 10%. They gave a bluish tinge when fluoresced in ultra-violet light.

The data confirm the proposition put forth before that low R.M. genuine ghee can be distinguished from adulterated samples by estimating the linoleic acid content of ghee. This can be confirmed by a fluorescence analysis in ultra-violet light.

152. On the Bleaching Properties of Indian Clays.

S. C. CHAKRABARTY *and* R. K. DUTTA ROY, Calcutta.

Bleaching properties of some of the Indian clays have been studied. It was found from the data available that clays treated with 5.0%HCl for activation gave good results, the clays having good bleaching properties when Silica and Sesqui-Oxides are present in almost equal proportion. The results so far obtained seem to be interesting and further investigation is in progress.

153. Electrolytic Production of Persulphuric Acid on Semi-commercial Scale for the Electrochemical Preparation of Hydrogen Peroxide.

D. SINGH *and* A. BANDYOPADHYAY, Banaras.

Literature shows that the optimum conditions for the production of persulphuric acid are available at low temperature 0.5°, which is very difficultly maintained in a tropical country like India. The optimum conditions at a conveniently maintainable temperature has already been done by Sheshadri (*Proc. Ind. Sci. Cong.*, 1942, Part III, p. 43). The results are reinvestigated in considerable detail; the optimum conditions are: anodic C.D.=61.0 amps. per sq.dcm; cathodic C.D.=125.0 amps. per sq.dcm; interelectrode distance=5.0 cm; concentration of the electrolyte=60.0 % H_2SO_4 (Sp. gr.=1.505); temperature=20.0°C; electrode material used=platinum. The maximum current efficiency is 70%, with the progress of electrolysis for half an hour. The increase in volume necessitates the corresponding increase in current to keep up the desired current efficiency; but it is observed that the current need not be in the same proportion as the volume. For a particular volume a definite magnitude of current produces the best yield.

The yield obtained with a fresh solution of sulphuric acid and that which has been kept to stand for 20 hours after electrolysis and re-electrolysed have been compared. During half an hour interval of electrolysis the yield of perdisulphuric acid is almost

the same in both cases but in the latter case the formation of permonosulphuric acid is considerably low. The use of two anodes in place of one diminishes the yield to almost half of its former value. This is in agreement with the finding of Berthelot that with increased area of anode the possibilities of the decomposition of persulphuric acid increase and consequently the current efficiency diminishes. (T. Slater Price. 'Per-acids and their salts'. Longmans, Green and Co., 1912. p.14).

154. Catalytic Cracking of Kerosine Oil.—Part II.

S. S. Ghosh.

Pilot plant investigation into the economic possibility of making laboratory gas by catalytic cracking of kerosine oil has been carried out. A brief description of various parts of the plant made by assembly of readily available materials is given. The essential features of the plant, such as the pressure heating arrangement for vapourisation of oil and the design of a suitable immersion heater are described. Calculations based on a tentative heat balance are embodied which enable the capacity of the unit to be determined. Experiments with the plant indicate the possibility of a minimum yield of 35 c.ft. of fairly rich gas suitable for laboratory burners at the expense of 1 K.w.h.

155. Decarboxylation of Fatty Acids.

M. Chakrabarty *and* M. Goswami.

In continuation of previous paper on the subject (*J. Ind. Chem. Soc. Ind. & News Ed. Vol. IX.* Nos.3 & 4, 1946) in which we had shown that oleic acid, a bye-product in the manufacture of stearic acid, is decarboxylated in presence of catalysts like Kieselghur, Zinc, Nickel, Copper etc. into hydrocarbons, we have tried various other catalysts and studied the conditions in detail.

Oleic acid vapour was passed over Cu and CuO at a temperature of 380-385°C,under reduced pressure. But results were obtained with reduced copper. Separation and analysis of the products formed were done. The effect of re-cracking the primary product under the same conditons was also studied.

156. Moulded Articles from Glue.

S. K. Basu *and* M. Goswami.

The purpose of the present work is to prepare a suitable thermo-hardening moulding powder from glue and a plasticiser for the same. Previous attempts have been made by various reagents to harden glue of which formaldehyde and dichromate are the notable examples. For our purpose, firstly, we prepared glue powder by dehydrating it in inert solvents. This was mixed with powdered hexamine and the moulding characteristics were noted.

157. On the Preparation of Desizing Agents.

H. N. Chatterjee.

An extract suitable for preparing active desizing agent has been made by growing a strain of *Aspergillus Oryzae* on an acidified wheat bran admixed with 25% fat-free ground-nut meal and 1.25% sodium phosphate. The activity of the extract as measured from lowering of viscosity of a starch solution, compares favourably with similar extracts made from a commercial desizing agent exported from abroad.

158. Studies of Some Factors Affecting the Characteristics of the Dry-cell.

N. N. S. Sidhanta, Banaras.

Effects of particle size of the main constituent of the depolarizer, *viz*, pyrolusite ore, the use of artificial or/and natural graphite in the depolarizer and substitution of zinc chloride by zinc bromide in the electrolyte of a dry cell were studied. The results are recorded betow.

It was found that the internal resistance of the cells with 50 and 100 mesh fine ore, was low in the beginning *viz.*, 0.17 ohms, whereas it was 0.35 ohms in those with 200 mesh fine ore. The watt-hour capacities were 3.88, 4.70 and 3.58 respectively. The life of the cells with 100 mesh fine ore was found to be the longest and that of cells with 200 mesh fine ore the shortest.

The change in the nature of the graphite used *e.g.*, natural, artificial or a mixture of the two varieties was found to bring about no marked change in the properties of the cells.

The substitution of zinc chloride by zinc bromide was found to increase the initial internal resistance and decrease the life and watt-hour capacity of the cells, the latter being only 3.72.

159. The Tensile Strength of Synthetic Fibres.

P. S. VARMA *and* ABHAYA SINHA, Banaras.

The synthetic fibres from (a) hemp, (b) jute, (c) bamboo, (d) linen waste, (e) waste thread from mills, (f) commercial cotton, (g) cotton linterns and (h) surgical cotton, have been prepared on Higihara model Viscose Rayon Spinning Machine obtained from Messrs. Kotak & Co., Osaka, Japan and their tensile strength compared.

160. Studies in Processing of Tangerine Juice.

A. N. BOSE *and* A. K. GHOSH.

Canning of tangerine juice is difficult because of the delicate flavour of the juice which cannot be reserved by methods now in use for processing of other citrus juices. Moreover, the optimum conditions for deaeration which is necessary for retention of vitamin C in the juice, are not known. In this study it has been observed that a minimum of 1.6 percent, by volume, of air should be allowed to remain in the juice, when canned; otherwise juice will taste very flat. Loss of vitamin C due to 1.6 percent of air in the juice is negligible even after two months storage at 28°C. A temperature of 31°C and vacuum of 20 inches of mercury will provide the optimum conditions for deaeration. A sample of juice, deaerated under optimum conditions to 1.6 percent (by volume) of air and pasteurised at 86°C. for 15 secouds, retains, when canned, its flavour and its original vitamin C content almost unchanged for at least two months at a storage temperature of 28°C.

161. Investigations of the Indian Lemon Grass Oil.

H. G. BISWAS, Calcutta.

Conditions for the isolation of pure citral from Indian Lemon grass oil have been successfully established in the laboratory. Difficulties in the conversion of the process into the large scale preparation with a view to the economic production of ionone in India have been pointed out.

162. Possibilities of Earth as a Building Material in India.

N. K. PATWARDHAN, Roorkee.

The paper reviews the possibility of utilizing earth as a suitable building material in these days of scarcity of the conventional building material. Buildings in Pisede terre and adobe have been described with details of construction in both the cases. The inportance of moisture content in the soil mixture is stressed. The processes have been modified and compared in order to decide which of these would suit our requirements. Simple test for determining sand, even by a layman, has been described. Reference is also made to the use of different indigenous substances as soil stabilizers used at the Building Research Unit by the author. This includes gum, resins and lime-sludge. The last substance has been found quite useful as internal water-proofing. agent together with ramming. This substance which is wasted annually in thousands of tons by the sugar factories as a bye-product would find a very useful application in the construction of low cost housing, using adobe blocks (kuchha bricks) and suitable water repellent mud plaster of lime-sludge.

163. Bactericidal Action of Some Organic Mercuri-compounds of Aryloxy Fatty Acids.

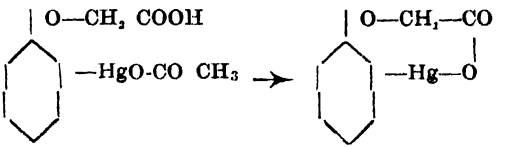
SACHINDRA KUMAR DUTTA *and* S. S. GUHA SARKAR.

The aryloxy acetic and propionic acids used in the investigation were prepared according to standard methods and recrystallised from hot water. Phenoxy acetic acids from phenol, o-, m- & p-cresols, o-m, and p-nitrophenol, o-m- and p-chlorophenols, α and β naphthols, guaiacol and thymol were known, as well as the phenoxy propionic acids from o-cresol- and o-nitro phenol. In most of the cases only the m-p's are recorded and neither the methods of preparations nor their reactions are described. The physiological effects of the majority of these compounds have not been studied.

The equivalent weights of unknown acids were determined by titration with standard alkali in dilute alcoholic solution.

The mercuri-derivatives were prepared by the method given in text book of Inorganic Chemistry by J. N. Friend, Vol XI, part 7 (1928). Only seven acetoxy mercuri-derivatives *viz.*, those from phenol, o-cresol, o-chlorophenol, thymol, α and β naphthols and guaiacol are known. The others were new.

Estimation of mercury was carried out by the Gold crucible method. The data and determination of the equivalent weights indicated that the compounds were the anhydrides of the hydroxy mercuriphenoxy-acetic acids and not the acetoxy derivatives as might be accepted.



Di-mercury compounds could be prepared by using two molecules of Hg acetate. These derivatives were not studied in detail.

The mercuri derivatives were practically insoluble in water and organic solvents, but were soluble in NaOH from which dilute acids reprecipitated them unchanged.

They were decomposed by warming with dilute HCl or NaCl solutions but not by shaking with $(NH_4)_2$ S. Neutral solutions of the acids gave insoluble precipitates with $CuSO_4$, $P_b(OAC)_2$ $FeSO_4$, and $ZnSO_4$ but none with Barium chloride or Calcium chloride.

Anhydrides of acetoxy mercury-phenoxy propionic acids were prepared in the same way and very similar properties were shown. These were somewhat more easily decomposed by HCl and $(NH_4)_2S$.

Bactericidal Test

For testing this action the Rideal-Walker drop method was followed. The organisms chosen for study were fresh cultures (24 hours old) of B. Coli and B.Paratyphosus B. Except a few, all the compounds easily dissolved in dilute NaOH to give nearly neutral solutions which were used in the tests, and were diluted with twice distilled water for the dilution tests. The pH of the solution and of the medium employed for the growth of the organism varied between 7.4 and 7.8. The temperature was 29°C.

The maximum effective dilution (concentration which prevented growth of B. coli) varied from 1 in 10,000 in the case of Phenoxyacetic acid derivative to 1 in 170,000 in case of p-iodo phenoxy acetic derivative. In case of B. paratyphosus B, the corresponding figures were 1 in 10,000 in case of the first and 1 in 130,000 in case of the p-iodo compound.

The unmercurated phenoxy acetic and propionic acids were very much weaker in activity; the maximum effective dilution varied from 1 in 700 in case of the first and 1 in 4,000 in case of β naphthol derivative and p-iodophenol derivative.

This clearly showed the large increase of bactericidal action on the introduction of Hg in the mol. Below is given a list of the compounds studied: They were the anhydrides of the hydroxymercuri derivatives of: 1. phenoxyacetic, 2. o-cresoxy acetic 3. m-cresoxyacetic, 4. p-cresoxyacetic, 5. o-Nitrophenoxyacetic, 6. m-Nitro.., 7. p-nitro.., 8. o-chloro.., 9. m-chloro.., 10. p-chloro.., 11. α-naphthoxy.., 12. β-naphthoxy.., 13. o-xylenoxy.., 14. m-xylenoxy.., 15. guaiacoxy.., 16. thymoxy.., 17. p-Iodophenoxy..,

18. β-phenoxypropionic, 19. β-o-cresoxypropionic, 20. β-guaiacoxypropionic, 21. o-nitrophenoxypropionic and 22. p-nitrophenoxypropionic.

164. Rapid Alkalimetric Method of determination of Magnesium in Carbonate ores of Calcium and Magnesium.

S. C. SANE *and* M. S. TELANG, Nagpur.

An acid-alkali method using lime water is recommended for the rapid estimation of magnesium in carbonate ores for limestone prospecting work for Portland cement manufacture. The main advantage of this method is that magnesium can be estimated rapidly even in the presence of iron and aluminium, the usual impurities in the ore. The reagents are inexpensive and readily available for routine analysis in Portland cement works laboratories.

165. On the Mechanism of Viscosity of Liquids.

M. S. TELANG, Nagpur.

A new viscosity-temperature relationship for liquids has been derived and its application has been studied. The derivation is based upon the theory of viscosity by Eyring *et al.*, rectifying the "activation energy" term. The "activation energy" term has been shown to be equivalent to the free energy of formation of a surface, and the error committed by previous workers regarding the evaluation of "activation energy" has been discussed. The proposed equation is free from any aribitrary or empirical terms and particularly not being derived from viscosity measurements, makes a direct calculation of viscosity possible.

166. Apparent Molal Volume of Sodium Chloride in Aqueous Solution.

BALBHADRA PRASAD *and* SHAYMASUNDER PANDA.

The apparent molal volume (ϕ) of electrolytes should be represented by an equation of the type; $\phi = \phi_0 + a\sqrt{c} + bc$ where 'a' is same for all electrolytes of the same valance type. There has been a good deal of difference in the results obtained with different salts of the same valance type. To see whether the differences are due to experimental error or are real, density measurements have been made to an accuracy of two in a million with help of two pyknometers of the same size, one containing solution and the other containing the solvent at the same temperature. The experimental value of 'a' is very nearly equal to the theoretical value.

167. Investigations on the Resin from Shorea Robusta.

D. MUKHERJEE *and* P. C. GUHA, Bangalore.

RESIN

| Ethyl acetate

Insoluble portion (A) — Extract

Ethyl acetate removed and treated with water

Insoluble portion (B) — Solution:

Alkalis

Insoluble neutral portion (C) — Soluble Acids (D)

Neutral ethyl acetate insoluble fraction (A). By fractional precipitations from benzene-alcohol mixture (1:2) and fractional crystallisation from ethyl acetate it was resolved into a crysatalline product, m.p. 170-80° and a product m.p. 208-10°.

Ether insoluble acids fraction (B). Purification by fractional alkaline extraction yielded a pure acid (with 5% ammonia), m.p. 308–10°; equiv. wt., 489. From the high acetyl value and the equivalent weight it seems to be a poly-hydroxy triterpene acid.

Ethyl acetate soluble neutral fraction (C). This is soluble in all organic solvents On fractional distillation two fractions, b.p. 175-80°/2 mm.; and 200-205°/2 mm., respectively, were obtained.

Ether soluble acid fraction (D). The fraction extracted by 5% ammonia, during fractional alkaline extraction from this fraction on working out gave an acid mixture (m.p. 200-204°; equiv. wt., about 600; absorbs bromine in the cold).

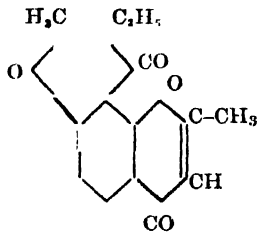
Chromatographic separation of the component acids was effected using benzene as solvent and columns of activated talc. The acids were located in far distant portions in the train of elution, by titration against N/100 alcoholic caustic potash. Each influx of acid eluted was rechromatographed till there was no further resolution.

Nature of active chemical groups, *e.g.*, carboxyl, keto, hydroxy, ester, etc., present in the constituents of the different fractions (A), (B), C), and (D) have been determined.

168. Synthesis of 2 :2′–Dimethyl–3′–ethyl–chromone–7 :8– -pyrone from 7–Hydroxy–8 butyryl–2–methyl–chromone.

G. R. KELKAR *and* V. S. KULKARNI, Poona.

7–Hydroxy–8–butyryl–2–methyl–chromone (Kelkar and Kulkarni, *Proc. Ind. Sci. Congress*, 1945, 140) gave by the action of fused sodium acetate and acetic anhydride, a neutral substance, $C_{16}H_{14}O_4$, m.p. 227°, (I), which on alkaline hydrolysis gave 2–butyryl–4–carboxy resorcin (Kelkar and Kulkarni, *ibid.*) by ketone-splitting of one of the pyrone rings and acid-splitting of the other pyrone ring yielding (i) acetone and (ii) acetic acid respectively as the other products of hydrolysis. (I) could, therefore, be represented as 2:2′–dimethyl–3′–ethyl–chromone–7:8–γ–pyrone,



169. Synthesis of 3–propyl–2′–ethyl–7′–8′-furochromone by the Roessing's method.

G. R. KELKAR *and* V. S. KULKARNI, Poona.

Dry sodium salt of 7–hydroxy–8–butyryl–2 methyl–chromone (Kelkar and Kulkarni, *Proc. Ind. Sci. Congress*, 1945, III, 140) gave by the action of ethyl-brom-acetate 7–carbethoxy–methoxy–8–butyryl–2–methyl chromone, $C_{18}H_{20}O_6$, m.p. 125°, (I), which on mild hydrolysis with caustic alkali furnished the corresponding acid, 7–carboxy-methoxy–8–butyryl–2 methyl chromone, $C_{16}H_{16}O_6$, m.p. 240° (decomp.) On heating alone or with acetic anhydride and sodium acetate (II) yielded by the elimination of carbon dioxide and a molecule of water, 3–propyl–2′–ethyl–7′:8′–furochromone, $C_{15}H_{14}O_3$, m.p. 155°.

170. The Electro-deposition on Non-conducting Surfaces.

D. R. DHINGRA, G. N. GUPTA *and* M. G. GUPTA, Kanpur.

The electroplating of non-conducting surface is not possible, unless they are rendered conductive by some means. There are three methods which are widely used to

obtain a metallic-coating on non-conducting surfaces, namely: (1) Metal Spraying; (2) Vacuum-Spluttering and Evaporation; and (3) Electroplating. The first two processes require the use of special apparatus. The third one has been dealt in detail in this paper.

In order to electroplate a metal on a non-conducting surface, it is necessary to form a thin conducting layer before placing it in the plating solution. This can be done either (1) by means of metal-powders or (2) by reduction of metals on the surface. Both these methods have been described. For copper plating acidic-copper sulphate, alkaline copper tartrate and cyanide baths have been tried, but only least acid copper sulphate and acid copper-sulphate baths have been found satisfactory.

The authors have successfully electroplated several non-conducting surfaces, *viz*: glass; plastics; wood; wax; plaster of paris and unglazed articles; porcelain and tiles, etc.

For copper plating glass it is first of all silvered by reducing ammonical silver nitrate either by dextrosol or hydrolysed cane sugar. Then it is copper plated first of all in the least acid copper bath and the copper film thus produced then thickened in the acid copper bath. The composition and optimum operating conditions have been given in detail in the paper.

For electroplating plastics in general and celluloid sheets in particular, first of all the surface is deglazed, cleaned and sensitised with 1% pyrogallol solution and then a thin silver film is deposited on it chemically. After drying, the silvered celluloid-sheets are copper plated, as in the case of glass, in the least acid copper bath and finally thickened in the acid copper bath. The copper plated sheets may also be plated with silver in the following silver plating bath. The composition of the recommended bath is as follows: Silver-nitrate 74 gm.; Potassium cyanide (95-96%) 82 gm.; Potassium carbonate 76 gm.; Sodium thiosulphate 1 gm.; water to make up to two litres. The optimum working conditions are as follows: Temperature 25-28°C,; voltage 3.0 volts; cathode current-density 40-45 amp./sq. ft.; plating time 60 seconds.

For electroplating of wood and wax, a conducting surface was obtained by applying a thin uniform layer of 6% collodion and after drying treating them similar to celluloid-sheets. Wax can also be made conductive by applying a layer of 1:1 copper powder and graphite and then silvering it as usual.

For electroplating of plaster of paris moulds and unglazed articles, they were first of all coated with wax and then treated as in the case of wax articles. Procelain articles and tiles were rendered conductive by direct silvering as in the case of glass plates.

171. The manufacture of Electrolytic Copper powder.

D. R. Dhingra, G. N. Gupta *and* M. G. Gupta, Kanpur.

Copper powder plays an important role in the manufacture of nearly 75% of all the metal powder parts. It also finds wide use in the electroplating of non-conducting surface—electro-typing, etc., besides other industrial applications. After describing briefly the four important methods of making copper powder namely, (1) by reduction of the oxide: (2) by atomisation of the molten metal; (3) chemical precipitation; (4) by electrolysis, the authors have given the details about the manufacture of electrolytic copper powder on a semi-large scale. The optimum working condition with regard to composition of the electrolyte, current-density, tank voltage bath-temperature, electrode-spacing, etc., have been determined. The relations between current-density and tank voltage, sp. gr. of the solution and the combined concentration of sulphuric acid and copper sulphate, sp. gr. of the powder, its particle size, etc., have been thoroughly studied. The results obtained considerably differ from those reported by Hothersall and Gardam ("The Industrial Chemist," *167*, April, 1945.).

It has been found that an electrolyte containing in solution 50 gm./L. of copper sulphate ($CuSO_4$, $5H_2O$) and 150 gm./L. of free sulphuric acid (sp. gr. 1.84) with a cathode current-density of 70-75 amp./sq. ft. at 1.5 volts works well at 25-35°C. The electrode distance may vary from 4.0″ to 5.0″. The various precautions that are necessary for proper working have also been mentioned.

In the end details about the necessary equipment and economics for producing 1 cwt. of loose copper powder per day of 24 hours have been given. It has been estimated that the cost of loose copper powder will be approximately Rs. 3/-/- per lb.

As the raw materials are available within the country, Indian capitalists should avail of the facilities to start the industry.

172. Survey of Reh Deposits in U.P.

D. R. DHINGRA, GANESH CHANDRA, G. N. GUPTA *and* V. N. NIGAM, Kanpur.

It is well known that soda ash and caustic soda are two of the most important chemicals required for the development of industries in the country. During the war time due to the transport difficulties their supply from foreign countries was much restricted. It therefore became essential to manufacture soda ash and caustic soda from the raw materials available in the country. Reh soil which occurs as a efflorescence on the surface of earth in usar lands during the dry months contains sodium carbonate to the extent of 3-20% along with other soluble salts like sodium chloride and sodium sulphate. This has been known to washermen who were using it for cleaning the textile goods, though it had not been exploited economically so far. Sajji has been made in the United Provinces since a long time and about 7-8 lacs mds. are produced annually. To develop this industry a survey of reh deposits occuring in various localities of the Province was made and the samples from these places were fully analysed in order to find out the composition of reh soils.

It has been noticed that good quality reh generally occurs by the sides of canals. Authors have shown that if all the reh available in our Province is utilised for the manufacture of soda ash the quantity would be much more than enough to meet our demands in the country.

173. Resins from Molasses, sugar and other Carbohydrates.

M. S. BHATNAGAR *and* S. ROY, Kanpur.

Dark coloured resins from molasses and phenol have been prepared. Experiments were conducted under pressure in an autoclave and also by refluxing the products with an acid catalyst. Optimum conditions of the reaction have been determined and it is found that the maximum yield is obtained when the reaction is carried out between two parts of molasses and one part of phenol.

Attempts to reduce the percentage moisture have all been made and a minimum of 0.09% has been recorded.

Experiments with sugar and other carbohydrates have also been conducted to produce lighter coloured products.

174. Studies in Cellulose-Acetates.

D. R. DHINGRA *and* B. B. MITHEL, Kanpur.

The authors have studied the manufacture of cellulose-acetates in its multifareous aspects. Various catalysts and reactants in different proportions at different temperatures, time of reaction, have been used. As the pretreatment of cellulosic raw material *i.e.* cotton etc. before the acetylation is of great importance, the effect of various treatments have been studied in detail and discussed in its comparative aspects.

The common catalysts used in acetylation of cellulose have been studied individually and discussed fully. Perchloric acid, sulphur dioxide and chlorine, zinc chloride, and sulphuric acid were employed as catalysts. Sulphuric acid, the universally employed catalyst on commercial scale, was studied in great details. It has been noticed that the time of action is reduced by increasing the quantity of sulphuric acid. It was observed that by increasing the concentration of sulphuric acid, the speed of acetylation increases, but after a certain limit of time, the degrading effect becomes very prominent. The desired commercial products can be obtained by varying the amount of sulphuric acid.

As the Government is planning the development of plastics and acetate rayon industry, the above work will solve most of the initial difficulties and the work will prove of fundamental importance to the industry.

175. Studies in the manufacture of Cellulose-acetate-butyrate.

D. R. DHINGRA *and* B. B. MITHEL, Kanpur.

Cellulose-acetate-butyrate, the most popular mixed ester of cellulose, is used as a plastic, lacquer, and coating material. It finds extensive use in the manufacture of aeroplane dopes, radio bodies and furniture, film making and lacquers for plastics and fine steel tools.

The manufacture of cellulose-acetate-butyrate happens yet to be a top secret. Studies conducted in its manufacture have met with considerable success. The weight percent acetyl and butyryl in cellulose-aceto-butyrate was found to be a mere function of the initial proportions of acetylating and butyrylating groups in the reactant mixture. For very high butyryl and acetyl content cellulose-acetate-butyrate, the use of both the anhydrides in the reactant mixture is essential. For moderately esterified cellulose-acetate-butyrate the presence of one of the anhydrides only is required. Very low acetyl and butyryl content aceto-butyrates can be manufactured without the use of anhydrides.

This fundamental study in the manufacture of cellulose-aceto-butyrate will be of great value to the Indian plastic industry which is going to be developed shortly in our country.

176. A Survey of Indian Cellulosic Raw Materials for the Manufacture of Rayon.

D. R. Dhingra *and* B. B. Mithel, Kanpur.

All the Indian cellulosic raw materials, which can be employed for the manufacture of rayon, have been studied in detail. Some of them have not been explored so far. Taking all the points into consideration, cotton waste and bagasse have also been found out as suitable raw materials besides several woods, which can produce chemical pulp for rayons.

Cotton waste, bye product of the 'Cotton spinning and weaving Industry', unsuitable for spinning and carding etc. (specially the soft waste), is quite a good and economical raw material. It does not need any elaborate chemical treatment like other cellulosic raw material, being merely an admixture of cellulose, dirt and earth, seed parts and straws etc. and can yield cellulose quite economically. The treatments required are mainly of mechanical nature. The authors have estimated that cotton waste alone, if available for the chemical cotton industry, would yield nearly 3,54,150 bales of chemical cotton anually. Chemical composition of cotton waste from various operations of the textile mills differs.

Bagasse, another raw material is obtained as a bye product in sugar industry. The processes of pulping of bagasse have been studied, but of the existing methods *i.e.* soda, sulphate, sulphite and nitric acid, the last method has proved best. By using the nitric acid method of pulping bagasse, the authors could get as high as 95% α-cellulose in the prepared pulp. As there are a number of sugar factories in U.P., very large amounts of bagasse can be available for rayon manufacture and it can be exploited commercially in the Province.

177. Plaster for Kachha Houses.

D. R. Dhingra *and* S. N. Ghatak, Kanpur.

Due to great shortage of building materials such as cement, bricks, iron. houses cannot be made to the desired extent. Mud and sun dried brick houses are to be made to a very great number. Mud and sun dried brick walls cannot resist rain and hence with a view to make suitable plaster for applying over sun dried and mud brick walls, a series of experiments were performed and a suitable plaster was evolved as follows :- (1) Kachha water pond clay—10 cu. ft. (2) Cow-dung—2.5 cu. ft. (3) Wheat straw—2 cu. ft. (4) Linseed fibre—1 cu. ft. (5) sunnhemp fibre—1 cu. ft. (6) mud from cattle farm—1 cu. ft. (7) Molasses 10 seers.

Suitable clay (soil) selection is essential as every clay does not serve the purpose as they are not identical and vary considerable in behaviour.

The selected clay was dried to const. weight and was analysed and the result was as follows :-

SiO_2=55.1% (Free silica was 15.0%), Fe_2O_3 & Al_2O_3=23.77%, CaO 3.31%, MgO 8.69%, Organic matter and Humus content 7.90%, Undetermined by difference= 0.73%;

Physical Tests :-

Tensile strength 210 lbs. per sq. inch, Liquid limit 45.9%, Plastic limit 20.3%, Plastic index=25.6%, Optimum moisture required 12.0%.

Clay from different ponds vary considerably. If necessary different proportions of different soils are admixtured in order to get the figures as above analytical figures.

The above formula was used for plastering the mud and mud brick walls and also for reinforced roofing.

The above formula was termed as A. To this A, B was added in equal volume and mixed intimately. The composition of B part is as follows :- (1) Press mud 10 cu. ft., Bagasse 4 cu. ft., Molasses 15 seers.

The process of stabilization :- The ingredients are mixed and kept dipped in water for 25 to 30 days and allowed to undergo biochemical fermentation changes, with occasional stirring by manual labour. If the stabilization period is increased the quality of plaster improves to a great extent. Chemical action during stabilisation is due to fermentation and chemical combination of various ingredients found to form a plastic mass.

A number of houses with (1) Mud, (2) sun-dried bricks and (3) sun-dried bricks with minimum (about 20%) amount of fired bricks of the total number have been constructed. Plastering of walls with stabilised mud was done. Some roofings were also made of stabilised mud over a bamboo strips screen (Jaffri) which acted as a reinforcing material. Walls and roofings were lime washed.

178. On Dalda Vanaspati.

D. MISHRA

Dalda Vanaspati in the opinion of the foreign as well as a few Indian Scientists is pure and wholesome food stuff. The original sample which was analysed in Imperial Science Institute, India and also Science Institute, Bangalore was found to contain cocoanut oil 20%, groundnut oil 20%, cotton seed oil 25%, Mohua oil 15% and the rest 20%, butter prepared by souring pure milk slightly by controlled enzymic action. Gradually small traders began to adulterate the Vanaspati inspite of the Government Notification of the Department of Food; The Vegetable Oil Products Controller for India hereby prohibit the manufacture, stock or sale of any vegetable oil product which does not conform to the following particulars :—

1. The melting point as estimated by capillary slip method shall be from 31°C to 37°C, both inclusive with a tolerance of 2°C either side. The product on melting should be clear in appearance.
2. It shall not have moisture exceeding 0.25%.
3. It shall not have unsaponifiable matter exceeding 1.5%.
4. It shall not have free fatty acid exceeding 0.25%.
5. It shall not contain any harmful colouring, flavouring or any other matter deleterious to health.

The following results were obtained in my Laboratory on Dalda Vanaspati of different samples.

1. Melting point.....34°.5C–42°C. The product on melting is not clear.
2. Moisture.....0.28%–0.78%.
3. Unsaponifiable matter...1.75%–2.2%.
4. Free fatty acid.....0.35%–0.74%.
5. Colour and flavour.....Doubtful.

Besides these, saponification value and Iodine value differ widely from those determined in different laboratories in India with the original sample.

In my opinion the present Dalda Vanaspati is adulterated and hence inferior to the original sample.

Further investigations on other points are incomplete and still under progress.

179. Alkyl Substituted Benzylamines.

N. V. BRINGI, N. L. PHALNIKAR *and* B. V. BHIDE, Poona.

β di (phenyl ethyl) amines have good local anesthetic, antispasmodic and analgesic activity. Benzhydryl ethers and N-benzhydrylamines have shown high antispasmodic activity. It appeared therefore worthwhile investigating α-alkyl benzylamines and their derivatives for their local anesthetic, analgesic and antispasmodic

action. In the present work α-alkyl benzylamines with or without substituents are described. These were put through a screening test for their local anesthetic activity in B. J. Medical College, Poona.

The following amines are prepared: α phenyl ethyl amine; α phenyl propylamine; α propyl benzylamine; α hexyl benzylamine; α (p-methoxy phenyl) ethyl amine; propyl p-methoxy benzylamine; α hexyl p-methoxy benzylamine; α tridecyl p-methoxy benzylamine; α heptadecyl p-methoxy benzylamine; α chlorophenyl ethylamine; α propyl chloro benzylamine.

α phenyl ethylamine, α hexyl p-methoxy benzylamine and α hexyl benzylamine have considerable local anesthetic activity.

In continuation of the work described in part I (*Abs. Proc. Ind. Sci. Cong.* 1948, Part 3, 36) these amines were tested for their antitubercular activity. α hexyl benzylamine and α hexyl p-methoxy benzylamine inhibited completely the growth of M. Tuberculosis in a concentration 1 in 1000.

180. Azo Dyes from Sulfa Drugs and o-, p-Alkyl Phenols and Alkyl Resorcinols—Part I.

N. V. Bringi, N. L. Phalnikar *and* B. V. Bhide, Poona.

In continuation of part I, o- & p- alkyl phenols and some of the alkyl resorcinols which are long known to have antibacterial properties, have been coupled with sulfa drugs such as sulfanilamide, sulfathiazole, sulfapyridine, sulfapyrimidine etc. The following dyes have been prepared.

Sulfanilamide is coupled with (1) o–n–propyl, (2) o–n–butyl, (3) o–n–amyl, (4) p–ethyl, (5) p–n–propyl, (6) p–n–butyl, (7) p–n–amyl, (8) p-n–hexyl and (9) n-heptyl phenol.

Ethyl resorcinol is coupled with (1) Sulfanilamide, (2) sulfathiazole, (3) sulfapyridine and (4) sulfapyrimidine.

n-butyl resorcinol is coupled with (1) sulfathiazole and (2) sulfapyridine.
n-hexyl resorcinol is coupled with (1) sulfathiazole and (2) sulfapyridine.

The above dyes have been tested for their antibacterial properties against M. Tuberculosis. It has been observed that they possess very little or negligible activity in the concentration 1 in 1000 as well as 1 in 500.

181. Azo Dyes from Sulfa Drugs and Halogenated Phenols, Resorcinols and Some of their Derivatives—Part II.

T. R. Ingle, N. L. Phalnikar *and* B. V. Bhide, Poona.

Combination of sulfa drugs with other substances having bactericidal properties has been a promising field for research.

This part deals with the dyes obtained by coupling sulfa drugs with the halogenated phenols and resorcinols which are known to have antibacterial properties.

Sulfanilamide is coupled with (1) o-chloro, (2) o-Bromo, (3) o-Iodo, (4) p-Chloro, (5) p-Bromo, (6) Tribromo-phenol, (7) Tribromo resorcinol, (8) Tribromo-resorcinol monomethyl ether, (9) Dibromoethyl-resorcinol.

Sulfathiazole is coupled with (1) o-chloro, (2) p-chloro and, (3) p-bromo phenol.
Sulfapyrimidines coupled with (1) o-bromo phenol.
Sulfapyridine is coupled with (1) o-iodo phenol.

These dyes have been tested for their antibacterial properties against M. Tuberculosis using Lowenstein-Jensen medium. Out of these the dyes from o-chlorophenol and sulfanilamide have been found to have some antibacterial property.

182. Studies in the Chemistry of Chromones—Part II. 6-Hydroxy Chromones.

T. R. Ingle, N. L. Phalnikar *and* B. V. Bhide, Poona.

In continuation of the work described in part I (*Abs. Proc. Ind. Sci. Cong.* 1948, III 36) the following chromones have been prepared by the interaction of 2 acyl hydroquinone, ethyl formate and sodium.

(1) 6 hydroxy 3 n-propyl chromone m.p. 119°C. (methyl ether m.p. 48-49°C.) (2) 6 hydroxy 3 iso-propyl chromone m.p. 190-191°C. (methyl ether m.p. 87-88°C.) (3) 6 hydroxy 3 n-butyl chromone m.p. 138°C. (Methoxy derivative m.p. 61°C.) (4) 6 hydroxy 3 n-pentyl chromone m.p. 146°C. (acetyl derivative m.p. 90°C.) (5) 6 hydroxy 3-n-decyl chromone m.p.115°C.

These chromones have been tested for their antibacterial properties on M. Tuberculosis. They completely inhibit the growth in the concentration of 1 in 500, but a slight growth has been observed in 1 in 1000.

183. Investigation of Some Methods of Determining the Glyceride Composition of Fats.—Part II.

V. V. Mhaskar *and* B. V. Bhide, Poona.

For the estimation of different glycerides in liquid fats, Suzki, Yokoyama and Hahsi (*J. Soc. Chem. Ind.* Japan *30*, 849, 1927; *31*, 117, 1928), Sahasrabudhe and Kale, (*J. Uni.* Bom. *2*, 37, 1932) have used the method of bromination of gycerides and subsequent fractional separation of the bromoglycerides. The same method has been modified by Vidhyarthi and co-workers (*J. Ind. Chem. Soc.* 1940, *17*, 87-95).

The same method has been used in this work to estimate different glycerides in a known mixture of the following synthetic glycerides.

(1) Tri-linolein (2) Oleo-di-linolein, (3) Linoleo-diolein (4) Tri-olein.

The results obtained are discussed. Oleo-di-linolein and linoleo-di-olein have been synthesised for the first time.

184. Chemical Investigation of the Oil from the Seeds of Caesalpinia Sepiaria (Roxb).

V. V. Mhaskar *and* B. V. Bhide, Poona.

The oil obtained from the seeds of Caesalpinia Sepiaria has been fully analysed. The following acids were found to be present. The percentage of the acids present are as follows :—

Palmitic acid 5.6 per cent.
Stearic acid 7.25 per cent.
(Probably) Lignoceric acid 0.5 per cent.
Oleic acid 23.5 per cent.
Linoleic acid 63.1 per cent.

185. Synthesis of γ (Substituted Phenyl) Δ^b Crotono Lactones.

V. K. Paranjpe, N. L. Phalnikar *and* B. V. Bhide, Poona.

In continuation of the work of Shaha and Phalnikar (*J. Uni* Bom. XIII, iii, 22 (1944) 2 alkoxy toluyl crotono lactones and 2;5 di-alkoxy phenyl crotono lactones have been prepared with a view to throw further light on the observations of the previous authors. They have been characterised by their functional arylidine derivatives.

The lactones have been prepared from the corresponding 2 alkoxy 5 tolyl and 2;5 di-alkoxy benzoyl propionic acids. The follwoing lactones have been prepared.

(1) γ 5-methyl 2-ethoxy phenyl Δ^b crotono lactone.
(2) γ 5-methyl-2-propoxy phenyl Δ^b crotono lactone.
(3) γ 5-methyl 2-n- butoxy penyl Δ^b crotono lactone.
(4) γ 5-methyl 2-iso butoxy phenyl Δ^b crotono lactone.
(5) γ 5-methoxy 2-iso amyloxy phenyl Δ^b crotono lactone.
(6) γ 2;5 diethoxy phenyl Δ^b crotono lactone.
(7) γ 2;5 di-n-propoxy phenyl Δ^b crotono lactone.
(8) γ 2;5 di-n-butoxy phenyl Δ^b crotono lactone.

These lactones as well as some of their arylidine derivatives have been tested for their anthelmintic properties on earthworms. It has been observed that these lactones, in general, are not more toxic towards earthworms, which supports the observation of Shaha and Phalnikar (*loc. cit.*).

186. Chemical Investigation of the Resins obtained from the Seeds of Ipomea Muricata.—Part I.

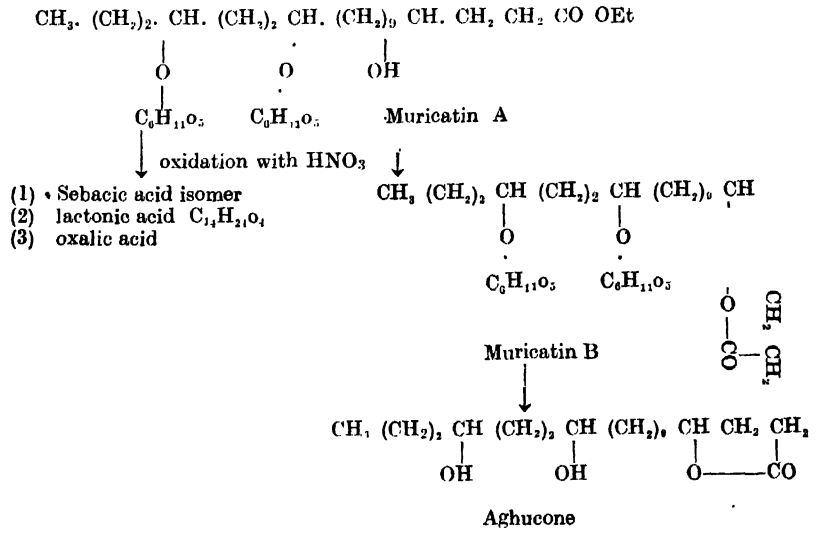
M. P. Singh *and* J. D. Tewari.

The seeds of Ipomea Muricata belonging to the natural order of Convolulacea has been reputed to be possessed with medicinal properties. On extraction with benzene the seed gave an oily substance which on standing separated into two portions, a viscous oil and a solid resinous mass consisting mostly of glucosides. The latter was however obtained in comparatively purer form by extracting the seed with alcohol and purifying the product thus obtained by partitioning in different solvents like petroleum ether, benzene and alcohol. In this way ultimately the resin was obtained as Muricatin A. This substance on oxidation with nitric acid gave three acids of the empirical formula, $C_{10}N_{18}O_4$ (m.p.116°-117°C) isomeric with sebacic acid, a lactonic acid $C_{14}H_{24}O_4$ (m.p. 98°-99°C) and oxalic acid.

Muricatin A on hydrolysis with alkali furnished a lactonic product, $C_{32}H_{58}O_4$, m.p. 104°-106°C which we have named Muricatin B. It crystallises in star shaped needles. Muricatin B on hydrolysis with acids gave an aglucone $C_{20}H_{38}O_4$ m.p. 53°-54°C, which is a pale yellow substance crystallising from ether in beautiful star like crystals.

The lactonic acid obtained from the oxidation of Muricatin A on being boiled with sodium bisulphite and subsequent acidification gave an acid $C_{11}H_{20}O_4$ m.p. 108°-109°C identical with undecandioic acid.

From the reactions described above the following structural formulae are suggested for the glucosides, Muricatin B and their degradation products.



187. Dyes derived from Adipic Acid.

Sadgur Saran Baijal *and* Ram Das Tiwari, Allahabad.

Adipic acid has been condensed with various aromatic hydroxy and hydroxy-amino compounds like phenol, resorcinol, catechol, pyrogallol, phloroglucinol, meta-amino-phenol and meta diethyl-amino phenol. The properties and behaviour of the dyes obtained as a result of these condensations have been described.

188. A Note on Changes Brought about in Oils on Keeping.

ANAND LAL MISRA *and* RAM DAS TIWARI, Allahabad.

In view of the fairly divergent results obtained by previous workers (Godbole and others: *J. Ind. Chem. Soc.* 1929, *6*, 295; Katti and Puntambekar: *J. Ind. Chem. Soc.*, 1930, *7*, 221), the oil of caesalpinia bonducella had to be re-examined before starting the studies on the glyceride structure of the oil. While carrying on these investigations (which will be published later), we came across a sample of the oil from these seeds which had been extracted in these Laboratories in 1933, and hence it became of interest to make a comparative study of the freshly extracted oil and the oil extracted about 15 years back. The following table gives the comparative figures: --

	Fresh oil	Old oil
Acid value ..	7.1	29.6
Saponification value ..	186.5	184.0
Acetyl value ..	30.0	61.3
Hehner value ..	92.8	92.5
Iodine value ..	105.4	109.8
Rancidity ..	..	..

With the development of rancidity, the acid value of the oil has considerably increased. The amount of the unsaponifiable matter in the oils of the seeds of the Leguminosal family generally exceeds 1% but in the present case it is not sufficient to account for the high acetylvalue of the oil. This suggests the presence of some hydroxy acid, but no such acid has been reported by any of the previous workers. The acetyl value of the oil has increased on keeping, suggesting the increase of the amount of hydroxy acid. The quantitative study of the component acids of the two oils is in progress.

189. The Effect of Various Groups and Ring Complexes on Carbon-Tetrahedral Angle.

L. D. TIWARI *and* J. D. TEWARI.

We have described elsewhere (under publication) a general method for the synthesis of $\beta\beta$-substituted adipic acids. In this paper we have determined the first dissociation constants of the acids thus obtained from a consideration of the carbon valency deflection theory of Thorpe and Ingold. The first dissociation constants are as follows:—

	Dissociation constant
Adipic acid ..	3.7
$\beta\beta$-dimethyl adipic acid ..	50.6
$\beta\beta$-diethyl adipic acid ..	163.6
Cyclopentane I-acetic -I-propionic ..	44.7
Cyclohexane I-acetic I-propionic ..	41.6

Comparison of the above values with the dissociation constant for the corresponding glutaric acids indicates that the carboxylic groups in such adipic acids were comparatively nearer to each other in comparison to what they are in the corresponding glutaric acids, though it is just the contrary in the case of the unsubstituted adipic and glutaric acids.

190. Dyes derived from 4-Phenyl 2:3 naphthalene dicarboxylic acid.

R. K. KAUL, Allahabad.

4-Phenyl-2:3 naphthalene dicarboxylic acid was obtained in good yield from phenyl propiolic acid by refluxing with acetic anhydride and the acid so obtained was condensed with phenol, resorcinol, phluroglucionol, o-, m-, and p- cresols to give dyes which gave deeper colour than the corresponding dyes obtained from phthalic acid.

191. The Effect of Unsaturated Chromophores on Pyronine Dyestuffs.—Part IV. Dyes Derived fron 2:6 Dihydrophthalic Acid.

I. N. DHARAM DASS *and* J. D. TEWARI, Allahabad.

In continuation of our work on the effect of unsaturated chromophores on the colour of pyronine dyes, we have prepared dyes from 2:6 dihydro-phthalic acid by condensing the same with phenol, resorcinol, catechol, o-cresol, m-cresol, m-aminophenol and phloroglucinol.

192. Chemical Investigation of the Active Principles of Oldenlandis Biflora.

R. N. CHAUHAN *and* J. D. TEWARI, Allahabad.

Oldenlandis Biflora (or Kshetrapartata, *Sans.*, Pittpapra, *Hindi*,) belonging to the family of Rubiceae was reputed to be possessed with some medicinal properties. On chemical examination we found that an alkaloid could be extracted from it which was obtained by extracting the plant with alcohol as a pale yellow coloured needles melting at 206°C and having an empirical formula, $C_{14}N_1O_3N$.

193. The Adsorption of Hydrogen and Carbon Monoxide on Fischer-Tropsch Catalysts:—Part I.

J. C. GHOSH, M. V. C. SASTRI *and* K. A. KINI, Bangalore.

The adsorption of hydrogen and carbon monoxide has been investigated by means of a volumetric technique in the temperature range from 20° to 250°, on two kieselguhr supported catalysts, one containing cobalt, copper, thoria, ceria and the other having chromium oxide also as an additional promoter.

With both these catalysts, activated adsorption of the two gases has been observed, that of hydrogen exhibiting two maxima on the isobar. Carbon monoxide was adsorbed in larger volume than hydrogen. This seems to be the general rule with Fischer-Tropsch catalysts.

The rates of adsorption of the pure gases have also been studied at various temperatures and pressures. From the data obtained from these measurements, the respective energies of activation of adsorption have been calculated.

The incorporation of chromium oxide as an additional promoter increases the amounts of adsorption of the two gases and their respective rates of adsorption, while reducing their energies of activation of adsorption.

194. The Adsorption of Hydrogen and Carbon Monoxide on Fischer-Tropsch Catalysts:—Part II.

J. C. GHOSH, M. V. C. SASTRI *and* K. A. KINI, Bangalore.

The adsorption of hydrogen and carbon monoxide from 1:1 and 1:2 binary mixtures of the two has been studied on the two cobalt catalysts mentioned in Part I of this series in the temperature interval, 25°C to 100°C. A thermal conductivity meter was employed to read the composition of the gas-mixture before and during adsorption. No reaction between the gases was detected at temperatures below 100°C., even on prolonged standing in contact with the catalysts.

In the case of the chromium-free catalyst, the adsorption of hydrogen is enhanced at all temperatures by the presence of carbon monoxide. The adsorption of carbon monoxide, however, is lower from the mixtures than from the pure gas, except at temperature above 97°C. The position is somewhat reversed in the case of chromium-promoted catalyst, on which the adsorption of carbon monoxide is enhanced and that of hydrogen depressed by the presence of the other gas.

It has also been observed that activated adsorption of either gas sets in at much lower temperatures in the mixtures than in the pure gases.

195. The Adsorption of Hydrogen and Carbon Monoxide on Fischer-Tropsch Catalysts.—Part III.

J. C. GHOSH *and* K. A. KINI, Bangalore.

Adsorption of hydrogen and carbon monoxide was studied on two nickel catalysts of the composition-nickel: thoria: kieselguhr ::100:18: 1000 and nickel: thoria: Chromium oxide: kieselghur :: 100 : 9 : 9 : 100 in the temperature range 0°-204°C.

As in the case of the cobalt catalysts, activated adsorption of both hydrogen and carbon monoxide was observed with these catalysts also, but the maxima of adsorption were found to lie at much lower temperatures. Further, the amounts of gases adsorbed were also greater.

Carbon monoxide was found to be taken up to a greater extent than hydrogen on these catalysts also.

The adsorption from mixtures could only be studied at 0°, because at higher temperatures hydrocarbon formation took place. At 0°, the presence of one gas suppressed the adsorption of the other.

196. Adsorption of Hydrogen and Carbon Monoxide on Synthetic Methanol Catalysts:—Part I.

J. C. GHOSH, M. V. C. SASTRI *and* S. VEDA RAMAN, Bangalore.

The adsorption of hydrogen and carbon monoxide, both from pure gases and from mixtures of the two gases, has been studied over a basic zinc chromate catalyst, prepared by reducing precipitated zinc ammonium chromate in a current of hydrogen at 400°C. With pure hydrogen activated adsorption sets in below 25°C. and the amount adsorbed increases steadily with temperature, reaching a maximum value at about 200°C. In the case of pure carbon monoxide, two maxima of activated adsorption have been observed, first at 52°C. and again at 250°C. From the rates of adsorption of the two gases, the activation energies have been calculated. From a mixture of the two gases containing two parts of hydrogen to one of carbon monoxide, hydrogen was preferentially adsorbed. Mixed adsorption could be studied only at temperatures below 30°C. as hydrocarbon formation became noticeable at higher temperature.

197. Adsorption of Hydrogen and Carbon Monoxide on Synthetic Methanol Catalysts:—Part II.

J. C. GHOSH, M. V. C. SASTRI *and* G. SANJIVA KAMATH, Bangalore.

The adsorption of hydrogen and carbon monoxide on a promoted catalyst containing copper, zinc, chromium, thoria and ceria, was studied. Activated adsorption of hydrogen sets in below 25°C. and the amount adsorbed increases with temperature even beyond 300°C., which is the highest temperature reached in these measurements. Activated adsorption of carbon monoxide starts at about 100°C. Adsorption from a mixture of the two gases could not be investigated with this catalyst as appreciable hydrocarbon formation was observed even at 25°C.

198. Adsorption of Hydrogen on Synthetic Ammonia Catalysts at Elevated Pressures.

J. C. GHOSH, M. V. C. SASTRI *and* H. SRIKANT, Bangalore.

A static volumetric method has been developed for the measurement of the adsorption of gases by solids at high pressures.

Employing this method, the adsorption of hydrogen on a promoted iron catalyst used commercially in the synthesis of ammonia, has been studied at pressures up to 50 atmospheres and at seven temperatures between 50°C. and 350°C. The results obtained indicate two types of activated adsorption: One occurring below 150°C and the other above 200°C.

199. Studies in Niobium and Tantalum—Part I, Lithium Niobate.

N. R. SRINIVASAN, Bangalore.

Extensive investigations have been conducted on the preparation of lithium niobate. Mixtures of niobium pentoxide and lithium carbonate were fused under a variety of conditions and the products analysed. The use of sodiun fluoride as a flux has been tried. It has been found that the niobates formed are hard, infusible and insoluble massos, though Henri Guiter (*Compt. rend. 216*, 518, 1943) reports that lithium niobate is easly fusible and soluble. A new 4:3 lithium niobate has been prepared by the double decomposition of lithium nitrate with purified potassium niobate. The niobate obtained is a slightly soluble white powder of the composition $4\ Li_2O.\ 3Nb_2O_5.\ 15H_2O$.

200. Studies in Niobium and Tantalum—Part II. Lithium Niobotartrate.

N. R. SRINIVASAN, Bangalore.

The niobotartrates of sodium and potassium have been described in a previous paper (Srinivasan, Indian Science Congress, 1948, Sec. 4. p.5.). Lithium also yields a similar complex. The Lithium niobate prepared *viz.* $4\ Li_2O.\ 3Nb_2O_5\ 15H_2O$ was reacted with tartaric acid and the products of the reaction separated by fractional crystallisation. Lithium niobotartrate has been obtained as a white powder. Analysis reveals the composition as $Li_2O.\ Nb_2O_5,\ (C_4H_4O_5)_2,\ 8H_2O$. The properties of this compound have been studied.

201. Studies in Niobium and Tantalum—Part III. Niobotartrates of Ca., Sr. and Ba.

N. R. SRINIVASAN, Bangalore.

The niobates of the alkaline earth metals are insoluble substances. Therefore the niobotartrates of these metals are prepared by double decomposition of a soluble alkaline earth salt with potassium niobotartrate. The niobotartrates of calcium, strontium and barium are obtained as sparingly soluble white powders. Methods have been devised for their analysis. The following compounds have been prepared and studied :--

$CaO.\ Nb_2O_5.\ (C_4H_4O_5)_2$	$10H_2O$
$SrO.\ Nb_2O_5.\ (C_4H_4O_5)_2$	$10H_2O$
$4BaO.\ 3Nb_2O_5.\ (C_4H_4O_5)_6$	$16H_2O$

202. Studies in Niobium and Tantalum—Part IV. Tantalotartrates.

N. R. SRINIVASAN, Bangalore.

It has been found that Tantalum, which bears a very close resemblance to niobium in its chemical properties also gives rise to a new series of complex compounds called the Tantalotartrates. The reaction between potassium tantalate and tartaric acid has been studied. A potassium tantalotartrate of the comp osition $K_2O.\ Ta_2O_5\ (C_4H_4O_5)_2\ 9H_2O$ has been isolated and its properties studied. A similar sodium compound has also been prepared.

203. Estimation of Tartaric Acid.

N. R. SRINIVASAN, Bangalore.

A modified procedure for the estimation of tartaric acid by the potassium iodate method has been given by Unger and Haynes (*Analyst* 1946, *71*, 341,) and the reported results are high when small amounts of tartaric acid are involved. The method has been reinvestigated for small amounts of tartaric acid and a procedure recommended. Results within 0.5% error have been obtained. The method is applicable to tartrates.

204. A Qualitative Study of Flame Tests for Tin, Gold and Bismuth.

R. C. MEHROTRA, Allahabad.

H. Meissner's blue mantle test for tin has been studied and it has been found that the colour of the mantle differs with the halide taken. The tin salts in presence of hydrochloric acid and zinc give a blue mantle, in presence of hydrobromic acid and zinc they give a green mantle whereas in presence of hydroiodic acid and zinc they give a yellow mantle. It has been further found that the test is interfered by the presence of sulphate, nitrate and fluoride ions.

Reactions similar to the above have been found to be shown by the halides of bismuth and gold and hence precaution is necessary not to mistake a mantle given by them for the presence of tin. As a result of these studies, a new sensitive flame test for gold has been described.

It has been shown definitely that the blue mantle given by tin cannot be due to stannic hydride as has been supposed. A mechanism has been suggested for the above flame reactions of tin, bismuth and gold.

205. Studies in the Technology of Shark Liver Oil—Part XIII. Selective Hydrogenation with Platinum and Palladium Catalysts.

P. V. NAIR, T. A. RAMAKRISHNAN *and* H. SREEMULANATHAN, Trivandrum.

Brocklesby ("Marine Animal Oils") has indicated that, by a process of controlled hydrogenation, it may be possible to eliminate selectively the off-flavours of marine oils which are chemically accounted for by the less unsaturated substances. Hydrogenation was accordingly effected with concentrations of 0.1% and 0.2% of platinum and palladium catalysts at 120°C. Organoleptic tests revealed that complete elimination of fishy odour was brought about in 90 minutes with platinum while palladium took 60 minutes to achieve the same result. Loss of vitamin A to the extent of 25 and 20% occurred with platinum and palladium respectively. Such grievous loss of the vital nutritional factor renders these catalysts unsuitable for controlled hydrogenation.

206. Studies in the Technology of Shark Liver Oil—Part XIV. Selective Hydrogenation with Nickel Catalysts.

P. V. NAIR, T. A. RAMAKRISHNAN *and* H. SREEMULANATHAN, Trivandrum.

Finely divided nickel is a reputed catalytic agent for controlled hydrogenation reactions. We have employed this in three different forms in our experiments in the selective hydrogenation of shark liver oil. Raney nickel (0.2%) which has found extensive application both in research and in industry, brought about complete deodorisation in 60 minutes at 120°C., but the loss of vitamin A was 14%. Reduced nickel formate at 0.1% concentration effected complete deodorisstion in 150 minutes at 120°C., but here again the loss of vitamin A was 15%. These two forms were thus found to be unsuitable for selective hydrogenation.

Nickel loaded on Kieselguhr (1:1000) was found to give the most encouraging results. 0.25% concentration of this catalyst reduced the oil to deodorisation point in 45 minutes at 120°C., with a total loss of vitamin A of less than 7%. Higher concentrations tend to greater deodorisation at the same temperature, while at lower concentrations threshold of deodorisation is reached only very slowly.

207. Studies in the Technology of Shark Liver Oil—Part XV. The Hydrolytic Index as a Criterion of Purity of Oil.

P. V. NAIR, T. A. RAMAKRISHNAN *and* H. SREEMULANATHAN, Trivandrum.

In the part X of this series (*Proc. Ind. Sc. Cong., Abs.* 192, *58*, 1948) the authors have indicated the use of the "Hydrolytic Index" for the detection and estimation of the extent of adulteration of shark liver oil with groundnut oil in trade samples. This work has been extended to assess the degree of adulteration with other vegetable oils and fats, such as coconut oil, sesame oil and cow's ghee. It has been shown that the "Hydrolytic Index" can be successfully employed to get a fairly accurate idea of the percentage adulteration with any of these common edible oils.

208. Studies in the Technology of Shark Liver Oil—Part XVI. Mercuration of Deoxygenated Low Grade Fish Oil.

(Miss) K. PANKAJAKSHY AMMA, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

In a previous part of this series (*Proc. Ind. Sc. Cong. Abs.* 193, *59*, 1948) the authors had reported the results of experiments in the halogenation of the deoxygenated low grade shark liver oils. Mercuration of the hydrocarbons was effected by refluxing with mercuric acetate in a solution of the oil in ethyl acetate, amyl alcohol or absolute alcohol. The percentage proportions of mercury in the product obtained in each of these cases was 12.61, 14.44 and 19.82 respectively. The insecticidal and germicidal properties of the substances are being investigated.

209. Studies in the Chemistry of Plant Pigments—Part I. Synthesis of some Anthocyanidins.

(Miss) T. PANKAJAKSHY AMMA *and* P. V. NAIR, Trivandrum.

7-o-Benzoyl fisetinidin chloride and 3;3′:4′-trihydroxy-6-amino flavylium chloride have been prepared by the usual methods of flavylium salt synthesis with a view to compare their properties and colour reactions with those of the pigments of jacaranda and *Thunbergia eracta*.

210. Antioxidants for Shark Liver Oil—Part XII. Minimum Effective Concentration of antioxidants.

P. K. MATHEW, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

The antioxidant activity of a large number of compounds both organic and inorganic have been reported in these series. The substances which proved to have substantially enhanced the induction period of shark liver oil have been selected and their minimum concentrations required to warrant stability for a reasonably long period of time have been ascertained. The minimum concentrations of quinhydrone, α-naphthol, propyl gallate and l-adrenaline have been worked out for the liver oils of both tiger and pristis, the best known species of the Travancore coast. Of the promising antioxidants, l-adrenaline was found to be the most effective, satisfying as it does all the requirements of an ideal antioxidant. Propyl gallate comes only second to l-adrenaline in this respect.

211. Antioxidants for Shark Liver Oil—Part XIII. Synergistic Enhancement of Antioxidant Actions.

P. K. MATHEW, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

Exploratory studies on the synergistic enhancement of the antioxidant activity of a series of combinations of substances have been carried out with varying concentrations from 0.01 to 0.1%. The different groups studied were :-

1. Quinhydrone and Hydroquinone
2. Quinhydrone and l-adrenaline
3. Quinhydrone and orthophosphoric acid
4. l-adrenaline and orthophosphoric acid
5. Propyl gallate and citric acid
6. Iso-butyl gallate and citric acid
7. l-adrenaline and l-ascorbic acid

Excepting the feeble activity of combinations of propyl gallate and iso-butyl gallate with citric acid, none of them showed any augmentation of activity.

212. Antioxidants for Shark Liver Oil—Part XIV. Relation between Iodine Value and Maximum Peroxide Value.

P. K. MATHEW, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

It has been reported that the maximum peroxide value reached in a given sample of shark liver oil is a function of its iodine value. The peroxide values have been found in the same manner as reported in these series. Various samples of oil with widely divergent iodine values have been chosen for study. The iodine values and the maximum peroxide values when carried out under controlled conditions fall in the form of straight line graph from which the maximum peroxide value which the oil is likely to develop can be computed from a knowlege of its iodine value.

213. Studies in the Technology of Shark Liver Oil—Part XII. Deodorisation of Shark Liver Oil with Fermenting Media.

P. K. MATHEW, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

The Ayurvedic system of medicine recommends the use of milk for purifying certain therapeutic products. Deodorisation of shark liver oil was attempted by washing with cold and hot milk. The improvement in smell of the oil after washing encouraged us to experiment with the action of fermenting milk on shark liver oil. The oil after 36 hours' agitation with fermenting milk was completely devoid of its fishy odour. Other fermenting media like toddy and cashew fruit juice have also been successfully tried. The physical and chemical constants remained unaltered. Further work to elucidate the mechanism involved in the process of deodorisation by fermentation is in progress.

214. Travancore Marine Oils—Part V.

P. K. MATHEW, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum

The physical and chemical constants of several samples of liver oils drawn at the Government Shark Liver Oil Factory, Trivandrum, from known species of sharks have been determined. A number of bulk samples were also examined. A wide variation of the constants including their vitamin content has been observed.

215 Stability of Vegetable Oils—Part I. Coconut Oil.

P. V NAIR, C J. PHILIP *and* T. A. RAMAKRISHNAN, Trivandrum

Enhancing the keeping quality of vegetable oils is of outstanding importance for their prolonged commercial storage. Vegetable oils undergo rancidity changes if they are unscientifically expressed and stored. Being endowed with active natural antioxidants, these oils are not so readily oxidised as oils of animal origin.

Preliminary exploratory study as to the best method for appraising the degree of spoilage has been carried out. This relates to the dependence of Acid Value, Peroxide Value and the Oxidisability Value on the extent of rancidity. The Peroxide Value and the Acid Value are simultaneously followed to assess the spoilage. The Values obtained were in good agreement with organoleptic tests.

Coconut oil which undergoes ketonic rancidity has been carefully examined as to its keeping quality. The development of Peroxides is remarkably slow and this factor singly cannot be used for this purpose. Coconut oil to which 0.1% cobalt oleate (freshly prepared), an active pro-oxidant has been incorporated to induce violent peroxidation, was used as the control. The antioxidant activity of the following substances on coconut oil has been investigated.—

(1) Hydroquinone, (2) Quinhydrone, (3) Anthraquinone.

216 Travancore Marine Oils—Part V. Green Turtle Oil.

E. JOHN JACOB, P. V. NAIR *and* T. A. RAMAKRISHNAN, Trivandrum.

The oil of Green Turtle (*Chelonia mydas*) is a body oil obtained sometimes abundantly from the Travancore coast. The oil is expressed by boiling minced turtle mus-

cles and ladling off the top layer. This oil is of much therapeutic importance in cosmetic chemistry. Skin tonics made from this products are emollient in their action.

Two different samples of the oil were examined to study their physical and chemical characteristics which are given below:

	Sample I	*Sample II*
Specific gravity	0.9148 at 30°C	0.9168 at 30°C
Refractive index	1.4670 at 30°C	1.4690 at 30°C
Acid value	12	8
Iodine value	114	102
Saponification value	202.5	202.5
Reichert-Meissel	1.8	1.4
Polenske value	1.4	1.6
Titre point	24.8°C	24.8°C
Unsaponifiable matter	1.4%	1.6%

The solid and liquid fatty acids were separated by Twitchells lead-salt-alcohol method, and were found to be 26.7% and 73.3% respectively. This result was returned by both samples of oil.

Methyl esters of the solid and liquid acids were prepared, fractionated under reduced pressure and each fraction studied. It was found that turtle oil contained traces of C_{10} acids lauric, myristic, palmitic and stearic as saturated acids, tetradecenoic, hexadecenoic as satuarated acids, C_{18} and highly unsaturated acids such as C_{20-22}. But the C_{18} acid contained besides the oleic the highly unsaturated acid, Clupanodonic acid.

Ethical preparations like face-creams, glycerine soaps, unguents are in process of preparation from deodorised turtle oil. Selective hydrogenation as developed in this laboratory is being employed to yield odour free turtle oil.

217. Estimation of Small Quantities of Iron in Water.

V. KRISHNA PILLAI *and* N. S. VARIER, Trivandrum.

Though salicylic acid has been known to produce a violet colouration even with small quantities of ferric iron, it has not hitherto been used in the estimation of iron. Hence an attempt has been made to utilise this reagent in the estimation of minute quantities of ferric iron present in water. It was found that either a 2 percent solution in alcohol or a satuarated solution of the acid in 30 percent acetic acid would be enough to estimate colorimetrically quantities up to 0.1 part per million. The intensity of colour produced varies with different concentrations of iron. The effect on the colour, of change in the hydrogen ion concentration, influence of other ions, ageing effect and temperature have also been worked out.

218. Essential Oils of Travancore—Part II. Oil from Cloves Grown in South Travancore.

K. N. G. NAIR, N. S. VARIER *and* P. V. NAIR, Trivandrum.

The physical and chemical constants of clove oil obtained from cloves cultivated in South Travancore were reported in a previous communication (Abs. *Proc. Ind. Sc. Cong.*, 1948). On analysis this oil has been found to contain eugenol, acetyl eugenol, a- and b-caryophyllene, furfural and methyl alcohol, the last two being found only in traces.

219. Essential Oils of Travancore—Part III. Oil from Travancore Nutmegs.

K. G. N. NAIR, N. S. VARIER *and* P. V. NAIR, Trivandrum.

Myristica fragrans is grown as a garden tree in many parts of Travancore. Though the dried nuts find a ready market, there is no great industrial use for the material. The present work was undertaken both with a view to determine the characteristics of the Travancore oil and to explore the possibilities of its economic use.

The mature nuts yield 10.2% of an essential oil (moisture free basis). The oil gave the following constants :-

Sp. gr. at 30°C	..	0.8904
Acid value	..	0.119
Sap. value	..	5.43
Acetyl value	..	46.27
Index	..	1.4775

Further work on this oil is in progress.

220. Variations in the Hydrological Conditions of Sea Water at Trivandrum Beach During 1947-48.

V. KRISHNA PILLAI *and* N. S. VARIER, Trivandrum.

The intimate relationship between the occurrence of phyto plankton and the availability of nutrient salts has been established by many workers. But no data is available about the variations in the conditions of the waters of the Travancore sea coast during various seasons. With a view to fill up this gap, data are being collected by analysing weekly collections for density, hydrogen ion concentration, salinity, phosphate, nitrite and ammonia. Side by side with this the variations in the plankton intensity in this area as well as such of the physical conditions as rainfall, pressure, wind (velocity and direction) and temperature are being closely followed with a view to correlate them with the chemical data.

221. Oil from the Seeds of Sesbania Grandifolia

M. NARASINGA RAO *and* R. SUBBIAH, Waltair.

A preliminary investigation into the nature of oil from the seeds of Sesbania Grandifolia (Papilionaceae family) shows low Iodine value (22.7), high Acetyl value (92.5) and high percentage of crystalline non-saponifiable matter (20%). Hence detailed investigation into the nature of constituents is of special interest, which is in progress.

Sesbania Grandifolia, member of the Papilionaceae family, is an erect tree and produces seeds containing about 10% oil. A search in the literature has shown that the study of oil from the seeds has not been made. Seeds are collected in Vizagpatam District, Madras Presidency, dried and powdered and extracted with carbon-tetrachloride. The yield is about 10%. The oil is a viscous, dark coloured liquid. The characteristics of the oil and the mixed fatty acids are given in the following table.

TABLE I.

	Sap. Val.	I. V.	Acety. val.	Acid-val.
Oil	205.5	22.7	92.5	15.0
M. F. A. (75%)	226.5	48.2	60.8	—

Non-saponifiable matter .....20% (colourless crystalline solid)

A few preliminary tests were carried out with the mixed fatty acids. The mixed fatty acids were brominated in ether at ice temperature, but no crystalline precipitate could be obtained. On oxidation with alkaline permanganate in cold, di-hydroxy-stearic acid could be obtained. The mixed fatty acids, on extracting with Petroleum ether, left a small amount of resinous matter.

Detailed investigations into the nature of the constitutents in mixed fatty acid in the usual manner and in non-saponifiables by Phthalic anhydride method (Chibuall *et. al.*) are in progress.

222. Microphotographs of Mercuric Chloride Crystals of Different Homologues of Pyridine Bases of Coal Tar Origin.

A. B. GHOSH *and* S. K. CHATTERJI, Calcutta.

Pyridine Bases consist of several homologues of Pyridine. By fractional distillation pure substances were separated. They are (1) Pyridine $+3H_2O$ (an azeotropic form of pure pyridine) B.P. 94°C, (2) Pure Pyridine B.P. 115°C, (3) Picoline B.P. 135°C,

(4)Lutidines B.P.150°-155°C consisting partly of a water soluble fraction and partly a water insoluble fraction. By the addition of 0.3 c.c. of 2% mercuric cholride solution to 1–2 c.c of these fractions, precipitates were formed. These were examined under microscope and the microscopic slides were then photographed with the help of a microphotograph camera. Their Morphological characters are as follows: (1) Pyridine and its azeotropic mixture showed long needle shaped crystals converging into an apex like the shape of broom sticks, (2) Picoline showed diamond shaped rather square plates crystals, (3) Lutidines : (i) water insoluble fraction showed star-shaped crystals, (ii) water soluble fraction showed as amorphous phase. The detection of these crystalline and amorphous precipitates formed the subject matter of a paper entitled as "Observations on Detection of Denaturants in denatured spirit" read at the 28th Indian Science Congress, Beneres, 1941.

223. Determination of Sodium Bicarbonate in Pharmaceutical Preparations.

A. Bhattacharya *and* I. B. Bose.

It is a very common practice to incorporate or dispense sodium bicarbonate along with other alkali salts such as potassium citrate, sodium salicylate, etc., together with syrup and other drugs. The B.P. or B.P.C. methods even with their slight modifications for the estimation of sodium bicarbonate, could not be applied to preparations containing other alkali salts. In deep coloured solutions inconsistent results are obtained owing to the difficulty in reading the end point with indicators. The Hirch's method (*Analyst, 73,* 160, 1948) for acidimetric titration of dark coloured solutions by using dithizone as indicator is not applicable to solutions containing other alkali salts.

The solution containing sodium bicarbonate and the alkali salts is evaporated and ignited when all alkali salts of organic acids are converted to carbonates. The total carbonates thus obtained are estimated by titration against standard acid. The other alkali salts are determined by independent methods and their equivalent quantity of acid is deducted from the total titre. The amount of sodium bicarbonate is calculated from the difference.

In order to test the applicability of this method the sodium bicarbonate contents of nine samples of varying compositions were determined by the proposed method, and also very cautiously by other methods whenever possible by removing the interfering elements and repeating the experiments for obtaining accurate results. In eight cases the actual sodium bicarbonate contents varied between 1 to 2 percent, and the difference between the results by two different methods (proposed and other) varied between 0.02 to 0.06 percent in seven cases, and 0.1 percent in one case. One sample was prepared with 1 percent sodium bicarbonate and the corresponding difference in this case was 0.04 percent. The results obtained are quite satisfactory. Therefore, this method may be safely used with advantage for the estimation of sodium bicarbonate in pharmaceutical preparations in the presence of other alkali salts and coloured substances for all routine purposes.

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SECTION OF GEOLOGY & GEOGRAPHY

PRESIDENT: PROF. C. MAHADEVAN, D.Sc., F.A.Sc., F.N.A.Sc., F.N.I.

A. GEOLOGY

1. Petrochemistry of the Trap Rocks of the Chitaldrug Schist Belt, Mysore State.

C. S. PICHAMUTHU, Bangalore.

In an earlier paper (Recs. Mys. Geol. Dept. Vol. 28, 1930) the author published a brief account of the petrography and petrology of three distinct occurrences of trap rocks found in the Chitaldrug Schist Belt—the Jogimardi, the Dark Hornblendic, and the Bellara traps. In this paper, the chemical analyses of these rocks are given and their petrochemistry discussed.

2. A Note on the Eurite dyke of the Giridih Coalfield.

Y. K. AGRAWAL and N. V. R. SUBRAHMANYAM, Dhanbad.

The occurence of eurite dykes as pre-Damuda igneous intrusive rocks among the crystalline gneissic rocks of the Giridih Coalfield had been noted by Thomas H. Holland and Walter Saise in 1895, but there has been no further literature on these dykes. A recent visit to the locality by the above authors, has revealed some interesting characteristics of this dyke rock. One of the two eurite dykes traverses the felspathic gneiss near the southern boundary of the Giridih Coalfield at a point a little to the south of the junction of the Komaljore and Suni streams. Beside the dyke there are also intrusive pegmatites in this area. The dyke is definitely younger than the pegmatites as is shown by stringers of the former traversing both the felspathic gneiss and the pegmatites. Some of the eurite specimens are brecciated. A spring at this locality and slickensided rock surfaces also suggest faulting. A microscopic study of the eurite rock shows that the coarse grained granitic patches in the rock have all been derived from the pegmatites or the gneisses and are not the original constituents of the rock.

3. Studies on cleavage and joints in the Iron-ore series rocks, west of Chaibasa.

AJIT KUMAR SAHA, Calcutta.

The argillaceous and arenaceous rocks of the Iron-ore series to the west of Chaibasa are in a low grade of regional metamorphism. The oblique relation between the cleavage and stratification planes in these rocks has been brought out clearly in a stereographic projection of the two planes from the data taken at a number of places. Field observations show that, in general, cleavage got developed later than the folding. The orientation diagrams, prepared from the statistical study of quartz grain orientations in three specimens of quartzitic sandstones indicate that in these rocks the deformation is such as one would expect in the initial stage of regional metamorphism.

A study of these rocks further, reveals the presence of four distinct sets of joints. Two of these are more prominent and are of Mohr type, the obtuse angle between them being bisected by the direction of maximum stress. The other two

sets are almost parallel and perpendicular respectively to the direction of stress, and thus are of Cloosian type.

4. The origin of the Waltair Highlands.

C. MAHADEVAN and N. SATAPHATHI, Waltair.

The origin of the Waltair Highlands which are formed of a thick red loam deposit around isolated hillocks has been tackled mainly by sedimentary petrographic methods co-ordinated by field work. Samples, collected from the red loam formations, sand dunes and a bed of a torrential stream, were mechanically and mineralogically analysed and the resulting data were graphically represented. The mineralogical composition of the samples discloses that the red loam is derived from the decomposed products of khondalites, charnockites and granites of the area. The size distribution of various heavy mineral grains of the samples reveals that the red loam is most likely of fluvio-aeolian origin. The available field data indicate very little possibility of the red loam to be a raised sand bank, as postulated by William King. The presence of eoliths and palaeoliths in the pebbly and gravelly horizons of the red loam formation shows that the formation is of late and post pleistocene age. Field and laboratory data indicate the possibility of red loam being formed by the cumulative work of wind and water.

5. The Geology & Petrology of Kondavidu Hill Range, Guntur District.

A. NARASINGA RAO, Waltair.

The Kondavidu Hill Range in Guntur District, with the khondalites, charnockites (intermediate and basic varieties), leptynites and granites as the chief rock-formations was studied in its geological and petrological aspects by the author in detail in the field and laboratory. Systematic geological mapping of the area was carried out, with intense study of the field-relations.

The khondalites, with persistent strike and dip and bedded nature are usually confined to the western flanks of the range, while the basic charnockites, the more frequent of the two varieties traverse the khondalites as dykes and sills. The granites and leptynites form the main mass of the hills and the former show intrusive relationship with the khondalites and charnockites as these two are seen as enclosed xenoliths in the granites at various localities.

In the laboratory, detailed optic study of the micro-section of the various representative specimens, determination of pleochroic scheme, optic axial angle and extinction angle of the important minerals, and anorthite-content of plagioclase on the Federov's Universal Stage was carried out besides the micrometric analysis with the Dollar's integrating stage and chemical analysis by standard methods of rock-analysis of the chief types, namely khondalite, charnockites, granulite, leptynite and granite.

The petrochemical relationship were discussed after the method of Prof. Niggli.

The above investigations resulted in the following conclusions:

1. The khondalites are metamorphosed sediments, later granitized.
2. Leptynites and granulites are hybrids of granitic-khondalite intermixture.
3. Charnockites are post khondalitic but pre-granitic in age.
4. Intermediate charnockites are the products of interaction between basic charnockite and granite.
5. Mineralogical study revealed a positive hypersthene in one of the sections of the intermediate charnockite, with a 2V ranging from 69° to 77°.

6. The Geology of the Basic Rocks around Jalwa Pahar, (Santal Paraganas).

S. K. Dey and B. Mukherjee, Calcutta.

The basic rocks with their metamorphosed equivalents occur in the Jalwa (Jalve) pahar region (24° 22' 30"N and 86° 39'E approx.) covering an area of 10 square miles with a general trend of NNE-SSW.

The important varieties are (1) meta-gabbro with or without olivine, with augite, calcic plagioclase and hornblende, the latter showing synantectic relation with plagioclase and augite or iron ores, (2) pyroxene granulite, (3) amphibolite and hornblende schists. At contact with granite gneiss, diopside and scapolite (with apatite and epidote) make their appearance.

Though in the field these rocks appear to have intrusive relation with the granitic country rock, petrographic examination reveals a discernible effect due to the granite, and a close examination in the field shows intimate veining by dykes and apophysis of the granite.

Zones of shearing noticed in the granite proves cataclastic effect after the consolidation of the granite. The metamorphism of the gabbros to amphibolites was due obviously to regional diastrophism prior to or just preceeding the granite intrusion. Later the granite has affected portions close to it by its exudation and heat converting them into scapolite bearing and diopside bearing rocks.

7. On the Geology of the Manganese-bearing Rocks of Garividi and Garbham, Vizag Dt.

G. Prabhakara Rao, Waltair.

This paper deals with the Geology, of the rock formations of Garividi and Garbham, and with a special reference to the manganese-bearing rocks.

From the field and laboratory studies it is shown that the khondalites are original sediments now represented as quartzites, sillimanite-gneisses crystalline limestones and calc-granulites after intense-metamorphism. The occurence of sedimentary manganese-ores in the khondalites has also been shown, which are now represented as compact non-hydrated metamorphic ores after metamorphism. The khondalites are intruded by granites which has assimilated part or the khondalitic material as well as the manganese-ores resulting in a series of hybrid rocks the kodurites. A study of the manganese pyroxene from these rocks, by chemical and optical methods showed that it resembles Johannsonite in optical properties and stands unique by the presence of a high ferric iron. Analysis of the garnet from the kodurites at Duvvam showed that it was rich in grossularite, almandite and andradite. Since the formation of the kodurite, these were itensively altered by hydrothermal and meteoric water. As a result the apatite in certain places show gypsification in the margins and cracks. It is suggested that the action of sulphuretted waters brought a gypsification in the apatites and kaolinisation in the felspars, with a partial or complete distinction of the other silicates. The potash released during the decomposition of felspars was shown to have acted as a solvent in the released silica which was redeposited as opals and cherts. There is some amount of secondary enrichment in the ores by the action of solutions. The area contains large quantities of workable manganese-ores.

8. On some newly found patches of ultrabasic rocks near Chakradharpur.

S. K. Das Gupta, Calcutta.

In course of field work in December, 1946, the author came across some patches of altered ultrabasic rocks along the crest of densely forested ridges in the western sector of Seraikella State—about 6 miles S. W. of Chakradharpur City (B.N.Rly:):

These altered ultrabasic rocks occur as intrusive bodies in Mica-schists of Iron Ore Series and also as dykes in different formations nearby. These rocks are mostly represented by a greenish, fine grained, sheared Talc-Chlorite-Antigorite rocks but some of them particularly the dykes are coarse-grained and not sheared. Field evidences suggest that the coarser type represents a late intrusive phase and may be post-shear post Granite (Chakradharpur granite mass) in age.

From microscopic study, the following stages of alteration was traced out:—

(i) Serpentine rock (coarse-grained, non sheared) in the first stage, followed by-
(ii) Serpentine-chlorite rock.
(iii) Talc-chlorite-serpentine rock.
(iv) Talc-chlorite rock.
(v) Tough Potstone (mostly talc with appreciable chlorite) and
(vi) Soft Potstone or Talc rock.

It appears that the alteration was brought about by late hydrothermal solutions. The rock was, however, originally 'Peridotite' as seen by laboratory investigation.

Two mineral deposits are associated with the ultrabasic magma here *viz*-

(i) Pockets of Chromite that were formerly worked, and
(ii) Debris of Titaniferous Magnetite, the occurrence of which has been noted first by the author.

9. *An occurrence of cummingtonite-grunerite-anthophyllite-quartz rock in Kanigiri Taluk, Nellor district.*

A. P. Subramaniam, Madras.

A series of ridges striking NNE-SSW commencing from hill 275 a mile and half east of Pedda Alavalapadu (15° 19′: 79° 38′), and extending southwards for about six miles, contain, interbanded with quartzites, quartz-granulites and quartz-schists, a greyish blue rock composed largely of bladed and acicular aggregates of a mineral which was suspected to be sillimanite. Detailed study of the micro-sections of these rocks under the Universal Stage, has shown these minerals to be amphiboles of the cummingtonite-grunerite and anthophyllite groups. The former display inclined extinction and multiple twinning of the lamellar type and have the following optical constants:

$$2V = +72° \text{ to } 76° \quad C \wedge Z \ 18° \pm 2$$

while the latter display straight extinction with $2V = | 76° \pm$. Chemical analyses of these rocks show them to be rich in magnesia and iron, confirming the identity of the minerals established by optical study. Besides the amphiboles, these rocks contain quartz, a few flakes of muscovite and grains of pyrite and magnetite.

Chemical analyses of three specimens of cummingtonite-grunerite-anthophyllite quartz rock.

No.	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
1	51.68	14.40	12.80	3.98	1.98	13.78	tr.	0.58
2	51.48	14.60	10.44	6.16	2.74	13.18	tr.	0.54
3	50.88	17.30	9.50	2.90	1.58	15.44	tr.	0.43

10. The Rapakivi-like structure in the Epidiorite Injection gneiss of Dhanbad area.

N. L. SHARMA and Y. K. AGRAWAL, Dhanbad.

The authors record in this preliminary note the occurence of beautiful rapakivi-like structure in the epidiorite and injection gneiss of Damodarpur hillock near Dhanbad. The ovoids of felspar are usually circular or elliptical and may be as much as 5 cms in diameter. They are sometimes surrounded by felspar-quartz rims which may be up to 0.5 cm in width. The rocks containing these ovoids, especially the epidiorite, are associated with the olivine-bearing meta-norite and meta-dolerite of Dhanbad. A detailed study of the petrology of these rocks is under investigation. The occurence of the rapakivi-like structure in typically metamorphosed rocks of basic composition has not been recorded so far in India and the authors are of opinion that these structures are phenomena associated with the granitization and felspathization of rocks.

11. Para-amphibolites near Pahariagora, E. Manbhum.

S. SEN, S. RAYCHAUDHURI and B. MUKHERJEE

A series of amphibolites occur interbanded with, or as lenticular patches within, calc-schists and calc-granulites, forming a persistent band north of Pahariagora (E. Manbhum) in S. Bihar. The country rocks are sillimanite bearing schists and gneisses.

The amphibolites grade imperceptibly into the associated calc-silicate rocks and are without a facies belonging to the group. In general appearance and in mineral composition these amphibolites are quite distinct from amphibolites derived from norites that occur in other parts of the region.

These rocks consist of plagioclase and hornblende with little quartz, sphene, ilmenite and allanite (producing pleochroic haloes in hornblende); but the plagioclase is decidedly much calcic (An82) than one normal to an ortho-amphibolite, namely andesine.

Chemically too the rocks have distinctively high CaO and MgO but very little FeO and Fe_2O_3 and high alkalies with an excess of Na_2O over K_2O as contrasted with normal amphibolites. Even with such features the computed Niggli-value is plotted within the eruptive field of section Iv of his tetrahedron, a fact apparently against the para-origin. The difference in phase in the different parts of the rock are ascribable to the intrinsic variation in composition modified by addition of matter.

The hornblende fabric of the amphibolite was studied. The statistical fabric of the poles of the 110 cleavages give concentration along four zones on the *ac* plane.

An appreciation of the mineralogenetic factors would require a more detailed study of the chemical and mineralogical variation throughout the mass and a complete correlation of the fabric.

12. A Further Note On Petro-Geometry of Darjeeling Rocks.

S. RAY and S. SEN, Calcutta.

In a previous note to the Science Congress (1948) the quartzgrain fabric of two specimens from the garnet zone and one from kyanite zone in Darjeeling Himalayas were discussed. The present paper attempts a petrotectonic interpretation of the quartz fabric of sandstones from the Gondwana horizon of the same area.

The *ac* fabric of the specimen 84 (Gondwana sandstone) shows an imperfect girdle some 30° round *b* that has been broken up, the reconstitution has not, however,

been to the degree reached in the higher metamorphic zones. Accordingly beyond the region of complete blank 30° round *b*, the distribution is somewhat haphazard up to the periphery. The same description applies to the second diagram (195) in which, however, the *peripheral ac* girdle is more distinct.

Thus, the five slides studied so far, can be arranged in order of increasing metamorphism as below:—84, 196 (low Cataclastic), 138, 104 (garnet zone), 121 (kyanite zone). The small *ac* girdle is less and less pronounced in the higher zones. This girdle, thus seems to be a predeformational fabric which has been broken up and progressively pushed towards the periphery by the orogenic stress.

It may be recalled here that Ingerson described a small (30°) *ac* girdle in undeformed Siwalik rocks. It appears that the Gondwanas and the older rocks had a similar pre-deformation fabric.

Further work is in progress.

13. Hypersthene-spinel granulite and related symplektites.

T. N. Muthuswami, Madras.

The paper deals with hypersthene spinel granulite (Hypersthene Spinellite) and garnet hypersthene cordierite, spinel and sapphirine assemblages in an abandoned quarry at Ganguvarpatti (Lat 10° 10 1/2' Long 77° 42 1/2') Periyakulam Taluk, Madura District. This quarry supplied touchstones about a decade ago.

The microscopic features of biotite, garnet hypersthene, cordierite, staurotite and sapphirine are given in detail. Symplektites of hypersthene-spinel, hypersthene-sapphirine and cordierite-sapphirine are recorded. Sapphirine is said to occur as a result of an influx of soda:-

1. as a diffused growth from various centres in hypersthene
2. as a reaction zone at contacts of (a) cordierite and hypersthene (b) cordierite and biotite
3. replacing spindles of spinel.

The mode of origin of the minerals is discussed. It is observed that the chemical composition of the hypersthene spinellite is abnormal and that symplektites of sapphirine and hypersthene have been seldom met with.

14. Petrological notes on Pakhals and associated rocks, Warangal dt. Hyderabad State.

C. Mahadevan and E. Venkayya, Waltair.

The Pakhals series consist of garnetiferous micaceous phyllites, mica-garnet-staurolite schists, mica-garnet-andalusite schists, garnet-mica-kyanite schists, marbles, carbonaceous phyllites and quartzites. These are intruded by granites and basic rocks, blue quartz veins, and Pegmatites, along the southern margins producing contact effects such as baking, induration, and hybridisation with the development of contact metamorphic minerals. Hornblende-schists and ferruginous quartzites occur in proximity to and rarely in association with the Pakhal series. The paper records the petrology of the representative rock types of the Pakhals and associated rocks.

15. Notes on the hypersthene-granites and gneisses in the Dumka subdivision of the Sonthal Parganas in Bihar.

S. C. Chatterjee, Patna.

The paper deals with a group of hypersthene-bearing granites and granulitic gabbros which cut through the former occurring in different parts of the Sonthal

Parganas, such as near Trikut Pahar, and near Messanjor on the Mor river. The petrographical characters of the rocks and their field relations have been discussed in the paper and comparison made with other hypersthene-bearing rocks found elsewhere in India.

16. On the Recognition of "Dodguni Series" corresponding to the Middle Dharwars in Mysore.

B. P. RADHAKRISHNA, Bangalore.

Near Dodguni, a small town situated 25 miles west of Tumkur a wide variety of Dharwar rocks are exposed in an ideal condition. The quartzites which are developed quite prominently show remarkably clear current bedding markings. On the basis of these markings the correct order of superposition of the beds and the tectonics of the area have been worked out.

The succession of the strata as established with the help of the current bedding markings is as follows:

Dodguni series

Banded ferruginous quartzites
Crushed sericite quartzites
Phyllites and Mica-schists
Limestones-Calcareous
Limestones-Dolomitic
Limestones-Manganiferous
Phyllites and Mica schists in parts replaced by Manganese
Amygdular hornblendic flows alternating with current bedded quartzites.
Quartzites-Current bedded
Garnetiferous mica schists
Amphibolites.

The succession commencing from mica-schists and phyllites in part replaced by manganese and ending on top with phyllites and mica-schists bears a close resemblance to the succession worked out for similar rock types in Gangapur and other places in the Central Provinces. It is proposed to call this rock series by the name "*Dodguni Series*" and keep it as a type succession to compare with the succession in the neighbouring Dharwar tracts in Mysore.

17. The Relationship of the Palnads and Cuddapahs in parts of Guntur Dt.

T. MADHUSUDHANA RAO, M.Sc. .....

(Communicated by Prof. C. Mahadevan: Andhra University.)

The paper deals with the stratigraphic position of the Palnads in parts of Guntur Dt. The geological formations in this area consist of granites, conglomerate, quartzites, local sandstones, slatyshales and limestones. According to the field evidence and laboratory study the author has classified the quartzites and slaty shales of the area into two series consisting of two successive stages, namely Nullamalais and Kistna series of the Upper Cuddapahs. The Paland limestones have been studied in detail both on field and in laboratory and the author on the evidence classified them under 'Jummalmudgus' of the 'Kurnool' system. The conglomerate found near the hill 'Duvva-Bodu' to the north of Bhadrupalem, represents the unconformity between the Granites (Archaean) and the sedimentaries (Cuddapahs).

The microscopic study reveals that the Cuddapah limestones are crystalline and Paland limestones are cryto-crystalline, showing that the former have undergone appreciable amount of metamorphism while the latter scarcely exhibit effects of any metamorphism.

The Palnad limestones are rich in calcium carbonate with magnesium carbonate in negligible quantities. On a comparative study of the analyses of limestones it is found that the Palnad limestones correspond closely to the 'Bhimas', 'Sullavais and 'Vindhyan limestones, which are all homotaxial with the 'Kurnools'.

The presence of a pseudo-conglomerate(?) and the change in the amount of dip of the Palnad limestones represents a sort of time-gap or erosive-unconformity between the Palnads (Kurnool) and the underlying 'Kistna' quartzites of the Upper Cuddapah system. Thus the study of these 'Palnads' both in the field and the laboratory show that these are homotaxial with 'Kurnools'.

18. Correlation of the Bundelkhand granite, and associated rocks, from Mahoba area, Hamirpur District, United Provinces.

R. C. Misra, Lucknow.

The area under study lies between long. 79° 50′—79° 80′, and lat. 25° 15′—25° 20′, round about the town of Mahoba (25° 18′ N. and 79° 52′ E.) which is an important railway station on Jhansi Manikpur branch of the Great Indian Peninsula railway.

The imortant rock types found in the area are streaky gneisses (hybrid-gneisses), simple granites, quartz reefs and pegmatites, and dolerite. The hybrid-gneisses chemically and mineralogically and on field relationships are quite different from the simple pink granite, and have been formed by the soaking of the granitic juice in the older schistose rocks. After the granitic activity the residual magma has given rise to quartz reefs and pegmatites. The latest igneous activity in the area is in the form of a seven mile long dolerite dyke.

The presence of hybrid-gneisses proves not only the younger age of the Bundelkhand granite but its intrusive character. The Bundelkhand granite is, therefore, regarded post-Arawali in age contemporaneous with Singhbhum granite and the dolerite of the area has been correlated with the 'Newer Dolerite' of Singhbhum.

19. The relationship between Palnads and Cuddapahs in parts of Narasaraopet & Gurjal Tqs., Guntur Dt.

M. Krishna Murty, Waltair.

(Communicated by Prof. C. Mahadevan.)

The paper deals with the stratigraphic relations of the various formations with particular reference to the correlation of the Palnad beds. The area is geologically mapped, the field relationship and structure of the formations are carefully studied and laboratory investigations carried out on representative field collections. The rock-types of the area consist of granites of Archaean age, Phyllites, Quartzites and crystalline limestones of Upper Cuddapah age and the Palnad limestones. The Palnad and Cuddapah limestones, are analysed gravimetrically and volumetrically. The former have a high percentage of CaO with a negligible proportion of MgO whereas the latter contain much less $CaCo_3$ and $MgCo_3$ up to 10%. The Palnads are chemically and lithologically similar to Kurnools, Bhimas and Sullavais and differ from the Cuddapahs. Structurally the Palnads are disconformable with the Cuddapahs. No evidence either for faulting or inversion could be noticed in the area. From a consideration of all the available evidences, the Palnads are surmised to be Kurnools.

20. Microfossils and nature of coal in some Indian coal seams.

J. SEN, Calcutta.

An attempt has been made to establish a correlation between the organic constituents of coal, and types and nature of coal in bituminous seams of Indian Lower Gondwana Coalfields. For this purpose numerous samples have been examined from about 10 coal seams following the maceration technique.

The nature of coal is usually considerably influenced by the different plant components (woody elements, cuticles, spores etc.) and the species which have yeilded the seams. It has also been found possible to determine the specific plants from their microstructures from which the different components of coal, *e.g.*, Vitrain, durain and fusain, were derived. Similarly the approximate proportion of vitrain, durain and fusain contained in coal may be estimated from an examination of the maceration residues. It, therefore, appears that in future microfossil research will develop into a thoroughly practical method, and the data thus obtained may be useful to determine even the rank of coal. These correlations between the coal constituents and components have, however, serious limitations in some cases.

Usually vitrain contains least number of microfossils represented by a few speres, but durain contains numerous microfossils of different types, *e.g.*, spores, cuticles, other cell structures etc. Therefore, the relative amount of vitrain and durain in coal is determined by the quantity and quality of microfossils. Presence of too many cuticles always refer to too much of dull coal of inferior type. Fusain always contain abundant wood elements.

The following seams have been examined:—Ghusick, Satpukuria, Kushadanga. Lower Dhadka and Nega of Raniganj, Chope of Barakar and Karharbari of Karharbari stage. Bhadua seam of Karharbari and Laitryngew seam of the Cherra have also been incidentally examined. The analyses of most of the samples from these seams yeilded results as can be expected from the nature and type of coal of the test samples, *e.g.*, microfossil data shows that among the Raniganj seams examined vitrainised elements occur proportionately greater in Ghusick seam than in any other. Such possibilities are indicated above. The occurrence of the quantity and species of microfossils in different samples and their relative importance in the determination of the type and nature of all the coal samples from different seams have been discussed and described in detail.

21. The age of the Infra-Trappeans at Pangudi.

C. MAHADEVAN, & E. VENKAYYA, Waltair.

Outliers of Deccan traps occur in the neighbourhood of Rajahmundry and also near the village Pangudi, 12 miles west of the above town. The trap outlier is underlain south of the village Duddukur (4 miles west of Pangudi) by a series of fossiliferous grey, white and greyish white calciferous sandstones dipping in a S. E. direction upto 8° and constitute an important datum linq to fix the age of the traps. Owing to its position below the traps, these sandstones are referred to as Infra-trappeans. These extend beyond Duddukur upto Gowripatnam towards the north and Devarapalle towards west and pass down without any recognisable unconformity into Tirupati sandstones dipping in a S. E. direction. The exact relationship cannot be made out in other parts of the field owing to thick sandy soil at the junction of the two formations, the age of the Infra-trappeans cannot be fixed definitely on account of the conflicting nature of palaeontological evidence. To co-ordinate and supplement the field data, representative specimens of the two formations were collected at regular intervals as required for stratigraphical correlation by heavy mineral suites. Petrographical studies are in progress, and a discussion embodying the results of the field and preliminary laboratory study are recorded.

22. Actinocyclina crassicostata from the Pellatispira-Bed (Upper Eocene) of the Surat-Broach Area.

B. S. TEWARI, Lucknow.

This paper contains a description with figures of an *Actinocyclina* which was collected by the author from the Upper Eocene foraminiferal limestone occuring between Bodhan and Ghala, Surat-Broach region, Western India. It is shown that this is different from *Actinocyclina altiçostata* Nuttal of Middle Kirthars and identical with *Actinocyclina crassicostata* Douville described from the Priabonian (Upper Eocene) of Europe. The fossil is being recorded for the first time in India and its stratigraphical importance is discussed.

23. The Physical and Chemical Properties of Vermiculite occurring at Appenhalli,—Hassan District, Mysore State.

C. S. PICHAMUTHU, Bangalore.

Vermiculite minerals have recently been identified in several parts of Mysore State. In this paper, the chemical, physical, and optical properties of the variety occurring at one of these localities in the Hassan District are described.

24. A New occurence of Mahadevite with further studies.

E. VENKAYYA, Waltair.

(Communicated by C. Mahadevan)

Books of mica collected by Krishna Crucibles Company from the Khondaltic tracts of the East Godavari District were sent for investigation of its properties. The new specimen is opaque in thick sheets with a bronze colour and lustre, highly fresh looking yielding thin transparent, tough and flexible laminae. When subjected to high temperature it does not show any appreciable changes in colour, toughness and flexibility. From the percussion figure the plane of the optic axes is found to be perpendicular to the clinopinakoid. The apparent optic axial angle calculated from Mallard's formula averages upto 13°. The B--refractive index amounting to 1.586 equals to that of Mahadevite.

The pleochroic scheme of the mica is as follows:

X = pale yellow
Z = Y = Light brown
Absorption:—Y = Z > X.

The mica shows a close similarity to Mahadevite. Analytical work to confirm the similarity of the new specimen with Mahadevite is in progress. Discussion and correlation of the optical properties and chemical composition of the new specimen and Mahadevite will be published shortly.

25. Pleochroic Haloes in Indian Minerals.

M. S. DORAISWAMI, Waltair.

Since 1907 when Joly conclusively showed the radioactive origin of pleochroic haloes, they have attracted the attention of scientists from all over the world. Yet in spite of this, all the anomalies found in them, the occurrence of over-exposed, bleached, normal, dwarf and emanation haloes do not appear to have been sufficiently studied to warrant a true interpretation. Pleochroic haloes have been reported from a number of localities

in India, and important investigations have been carried out in India. Well-developed haloes in cordierite and bidalotite from the cordierite-gneiss of Mysore have been studied and preliminary measurements indicate the correspondence of calculated and measured values in the case of the new mineral bidalotite. Further investigations are being carried out.

26. On the Mica-Bearing Pegmatites of Tiruvur (Kistha Dt.) Madras.

N. GOPALAKRISHNA MURTY, Waltair.

(Communicated by Prof. C. Mahadevan).

The paper presents the Geology of Tiruvur area with special reference to the mica-bearing pegmatites. The deposits are situated on the plains of Tiruvur Taluq at different localities. The area is occupied by Archaean rocks consisting of garnet-sillimanite gneisses, mica-schists and quartzites. Charnockites, granites and pegmatites are intrusives into these formations. The pegmatite carries good books of mica and often occurs in association with the mica-schists.

Mica is of a fairly good quality. Its colour varies from ruby to colourless. But a green variety is also noticed. Books of mica vary in size from 66"—1' across and books of higher size (2—3 ft.) are also encountered as in the Gosavid pit. Mica is generally developed at the contact of the wall rock. Pegmatites traversing schists contain large quantities of mica. The assimilation of the mica-schist during the intrusion of the pegmatite has contributed to the formation of so much of workable sheet mica in the pegmatites. Mining in this area, though not highly encourging, is promising. If good deposits are encountered this area is likely to become a progressive mining centre.

27. Beach Sands of Vizagapatam.

P. MAHADEVAN and A. SRIRAMADAS, Vizagapatam.

A systematic petrographical study of the beach sands of Vizagapatam coast was taken up to get an idea of the source and distribution of various heavy minerals more especially of monazite. Samples were collected along the beach and were subjected to mechanical analysis and heavy mineral separation. The resulting heavy fractions were divided into magnetic and non-magnetic parts using an electromagnet. The magnetic and non-magnetic parts were mounted on microslides and the percentages by number of different minerals were determined after identification. Computations have been made to obtain percentages of different minerals in different mechanical fractions and in the bulk samples. Extensive graphical representations have been made to elucidate the relations between the percentages of heavy minerals and sorting coefficients, distributions of heavy minerals in different size grades and etc.

The above study indicates that heavy minerals are concentrated at and near the mouth of the streams. The percentages of heavy minerals are more in finer grades. Monazite and zircon show close relationship. A moderate estimation shows that various minerals like ilmenite, monazite and zircon may be present in workable quantities in the black sand concentrates of the beach.

28. Geological Sketch of Kurupam Estate.

M. N. DEEKSHITULU, Puri.

Kurupam is an estate situated in the northern portion of Vizagapatam district Madras Presidency. Geological reconnaissance of this unsurveyed area was under-

taken with a view to estimate its mineral potentialities. The Geological formations are Khondalites, mica schists, Charnockites, Granites and Gneisses. Granulites are regarded as hybrids between khondalites and granitic intrusions. Pegmatites that cut khondalites containing disseminated graphite are found to contain workable quantities of graphite as near Kesari, and those that cut the mica schists are found to be rich in muscovite as near Bodikonda and Chetaladanimetta. Semiprecious beryl (at Bodikonda), Kaolin (at Chetaladanimetta Tumbali and Kotapadu), and red ochre (at Tadikonda), Sillimanite (at Baidi Hill) are worth mentioning. From these observations it is concluded that a detailed survey followed by prospecting may reveal many workable deposits of the above minerals.

29. "The Prospecting and Correlation of Coal seams in Ramgundum area, Hyderabad State."

HAMZAH ALI, Hyderabad-Deccan.

The prosepecting work for coal in Ramgundum area was conducted in 1945-47. The paper discusses the relation of the coal seams with each other in the Baragar beds of the area prospected.

There are four ocal seams with average thicknesses of 18ft., 11ft., 25ft., and 15ft., respectively with in 3.4 miles of length.

A plan, two sections, 18 logs of boreholes are appended with eleven photographs illustrating the boring operations.

30. A Note on the Quartz Reefs in the Bundelkhand Gneiss, Gwalior State.

K. V. KRISHNAMURTY RAO, Gwalior.

Bundelkhand Gneiss covers a large area in the unions of Madhyabharat and Vindhyapradesh. In Gwalior State; (Madhyabharat) the Paraganas of Karera and Pichhore, Shivapuri District, and parts of Chatigaon and Pichhore Paraganas, Gwalior Gird District are covered by these Gneisses and Granitees. In the Neemuch Paragana, Mandsaur District Outcrops of Bundelkhand Granites are found in the outlying Villages of Palia, Nikumbh, Jharsadri, Peepalwas Etc.,

Quartz reefs having a general strike of NNE-SSW form a striking feature of the Gneissic Country. The strike varies from NNE-SSW to NE-SW. Six such parallel reefs are traced in this area. A few reefs running E-W are also found in Pichore Gird Paragana. They often rise to three hundred feet in height the entire rock being broken up by joint planes. These reefs often run for more than fifty miles, broken of course at intervals where alluvium covers the viens.

Economic minerals in reefs are Argentiferrous Galena in Aindher, Karera Paragana, Shivapuri District, Soapstone in Khurhaj-Rajnur Area, Pichore Paraganas, Shivapuri district, a large quantity of Amethyst, rose to smoky Blue colour, occurring as thin veins in the reefs all over, and crystal aggregates of clear and opaque quartz in druses at various places. Traces of copper stains on the Quartz crystals or as the Copper carbonate are also found in many places.

They seem to have intruded into the pre-existing gneisses, after the Par sandstones of early Bijawar (Gwalior Series) had consolidated. Clear evidences of the reefs intruding into the Par sandstones are found on the Par scarp near Sarayeepura Nihona, Bharas, Antri, Bhilowa and farther east. Many of these intrusions have been traced back to the main reefs, which are closeby. Whether or not, we can link up the origin of lead ores of Aindher with the intrusion of these reefs is a problem that has to be solved.

31. Outliers of Clay-Ironstone in the Nikubh Jagir., Gwalior State.

K. V. Krishnamurthy Rao, Gwalior.

Nikumbh Jagir is an outlying village in the Neemuch Pargana of Gwalior State, situated thirty-two miles NW of Neemuch Town. The area is comprised of Bundelkhand Granite overlaid by Aravalli Quartzites. Aravalli Shales and Slates, and a small patch of hornblende trap occur on the west. The eastern boundary of the Jagir consists of a ridge and just on the boundary of the Jagir are three small outliers of Clay-Ironstone unconformably resting on the Quartzites. The beds are almost horizontal. The clay which is greenish to white in colour is soft and friable. The beds which are from 2 to 3′ thick are interbanded with those of Jaspery Ironstone which range in thickness from 2″ to 6″. The southern most outlier is approximately 20′ × 20′ × 50′. The other two are approximately 20′ × 15′ × 10′ to 20′.

The Quartzites underlying these seems to be later than the Aravalli Quartzites. In them are contained big rounded pebbles of the earlier Quartzites. Judging from the nature of the deposit it is assumed that they belong to the Bijawar series, though it is not clear whether they can be correlated with the Clay deposits of Mandsaur.

32. Notes on the Occurence of Vermiculite in Mysore.

B. P. Radhakrishna, Bangalore.

Early this year Vermiculite was first noticed to occur associated with corundum-bearing rocks near Pavagada and a few other places in the Tumkur District. A few more important occurrences of the mineral have subsequently come to light and the paper gives a detailed description of the now known occurrences at Pavagada and Nidavanda in the Tumkur District and Bageshapura and Channarayapatha in the Hassan District. It is pointed out that Vermiculite is of hydrothermal origin and has developed only at the marginal portions of basic and ultrabasic rocks in contact with the intrusive pegmatites and gneisses. It is further indicated that in all the places examined it is either talc or hornblende which has altered to vermiculite and not biotite or phlogopite. The principal uses of vermiculite are furnished.

33. Alkali-rich clays from near Karekurchi and Janehar in the Tumkur District.

B. P. Radrakrishna, Bangalore.

Extremely fine grained clays white in colour, soft and greasy to the feel and coming off in the form of small lumps and cakes are soon exposed in some of the workings for manganese ore near Karekurchi and Janehar in Tumkur District. The results of analysis of the clays show them to be rich in alkali containing as much as 8 to 9 per cent potash, a character somewhat unusual in clays. The clays are described to be the residual alteration products of the underlying phyllites, the potash-rich character being due to the presence of minute particles of sericite. The extent of the clay deposits and the use to which the clays can be put are described.

34. Flotation of Chromite.

B. Sadasiva Raju, Bangalore.

Though gravity concentration methods are successfully adapted to beneficiate low-grade chromite ores, some interest has been shown in the possibility of utilizing flotation for this purpose. Flotation operation seems to offer particular advantages in the treatment of ores that must be finely ground to liberate the chromite, or those containing

gangue minerals of high specific gravity. The low-grade chromite ore used in this investigation, however, does not contain any heavy gangue, except serpentine and other silicates. In order to depress this silicate gangue minerals, a chelate-forming organic compound, like Alizarin Red was used with oleic acid as a collector at a range between 4 and 6. The results were encouraging showing a recovery of 54% Cr_2O_3.

35. Determination of Feldspars in some Aphyric Deccan Traps.

N. A. VEMBAN, Calcutta.

The average composition of plagioclase in uniform grained Deccan Trap is given as Ab_1An_2 by H. S. Washington (1922). Fermor (1935) in his article on the Linga traps writes that 'the plagioclase is a labradorite somewhat more basic than Ab_1An_1' (P. 353). When the norms of the Linga traps studied by Fermor and of the average of the eleven analyses of the Deccan Traps (including one Rajmahal trap) given by Washington are examined, it is seen that the amounts of albite and anorthite are about equal to each other, corresponding to the composition of Ab_1An_1. Thus a discrepancy is seen between the optical determination of plagioclase by ordinary petrographic method and the normative composition.

Bowen (1928 p. 141) attributes this discrepancy to the general tendency of petrographers to over-estimate the anorthite percentage by choosing the most basic part of the plagioclase, which, when zoned, is generally found in the interior of the crystal, and disregarding the quantitative importance of the outer rim. It will be seen, if a drawing is made to scale, that the outer shell need have only one-tenth the thickness of the whole crystal to form one-half the volume.

In this study the author determined on the Federov Universal Stage the core as well as the successive outer shells of the zoned plagioclase in four slides of aphyric Deccan Traps and drew Camera Lucida drawings of the crystals demarcating the several zones. The area of each zone was found out and the average An% for the crystal computed by allotting the An% of each zone according to its respective proportion.

Out of twenty determinations made, the averages in fifteen ranged between 46% An and 54% An and in five between 56% An and 58% An. A phenocryst seen in the Linga trap gave the highest average of 58% An. The highest limit of variation between the core and the outermost shell was 26% An. The maximum anorthite percentage for the core was 67% An and the minimum for the outer shell was 35% An. The average for all the twenty determinations was 52% An, corresponding closely to the normative composition arrived at from the analyses.

B. GEOGRAPHY

36. Landform Development in the Damodar Valley.

S. C. BOSE, Calcutta.

River Damodar and its main tributary the Barakar form sunken basin. north and south of the Hazaribagh Plateau. Three previously levelled surfaces occur in the valley, the middle one being the most conspicuous, being about 2000 feet high, and forming the surface of the plateau. A higher surface is noticed in the "Pats" near the source of Damodar and Lugu and Jhumra hills. Parasnath Hills is a gigntic monadnock between the two valleys. Other remarkable features are the plateau escarpments and table tops formed by the Supra Panchet sedimentaries. Landform development is discussed in the paper by dividing the area into a number of physiographic sub-regions. A block diagram has been specially drawn.

37. Plant Geography of the Damodar Valley.

S. C. Bose, Calcutta.

The paper deals with the natural cover found in the valley and its present condition due to deforestation. It gives various vegetational types occuring in the valley such as vast pure stands of gregarious Sals (Shorea robusta) extensive palas jungles (Butea frondosa) Mahua glades (Bassia latifolia) and savannahs of Kash or Kese (Saccharum spontaneum), Bena or Khas (Andropogon muricatus) and Hogla. (Typha elephantina). Possibilities of proper utilization of the forest wealth is discussed. A list of important plants and their uses is given.

38. "Water Resources of Pakistan".

Professor Maneck B. Pithawalla, Karachi.

It is generally forgotten by workers in diverse fields of human activity that the physical phenomena on the surface of the earth are related in many ways to the underlying geological features. Topography, Hydrography, dry and wet zones, earthquakes, seaquakes, floods etc., have much to do with the rocks of the earth. Actually all the land forms are the surface expressions of one underlying strata, evolved by nature for milleniums and aeons.

While considering the future prosperity of a State like Pakistan, the greatest possible emphasis will have to be laid on its *water resources,* especially in the western dry zone. That there will be a dearth of rich mineral deposits in the largely Tertiary rocks of Pakistan except petroleum and Tertiary coal cannot be denied. Pakistan's future industrialisation is bound to be affected on this account. Water will remain for long its most precious mineral and must be saved from running into the sea, the desert sands or the salt lakes at any cost. Every drop of water is needed for its development. Search for good water should precede search for minerals. Search for water-falls is also needed for Pakistan's potential hydro-electric power.

For this purpose all the development schemes will have to be considered *regionally* and *not provincially.* The river valleys will have to be treated as a whole and their tributaries to be trained first of all Contributions from glacier covers must be taken into consideration for the discharges of the rivers, particularly the Indus, the Chenab and the Sutlej. *Multi-purpose* projects will pay Pakistan in the long run and aerial surveys will have to be regarded as most profitable for hunting water currents. Researches into the navigability of the rivers should be undertaken side by side. Lastly, if the desert is marching northwards and eastwards, suitable steps have to be taken to prevent *sand-drift.*

39. The Agricultural Regions of Bihar.

P. Dayal, Ceylon.

An attempt has been made in this paper to divide the province of Bihar into four clearly defined agricultural regions, each of which is unified by some well-marked features which give it a distinctive quality and mark it out from the rest. These regions are:

1. The Wet Lowland 'Dhanhar' Tract, lying for the most part north and east of the Burhi Gandak river and dependent mainly upon rice, especially winter rice, grown almost without irrigation.

2. The 'Bhith' (including 'Diara') Tract, formed by the remaining portion of the North Gangetic Plain, and a small ribbon of lowland immediately south of the Ganges subject to deep and regular flooding during the rains. This is characterized by predominance of the 'rabi' harvest and the growth of the more valuable 'bhadai' crops which are here far more important than the rice crop.

3. The South Gangetic Irrigated Tract, comprising the whole of the South Gangetic Plain excepting the portion included under 2. Its chief distinguishing feature is its almost complete dependence upon irrigation for the success of its principal crops. Though rice is the predominant crop, a number of 'rabi' crops are also grown.

4. The Chota Nagpur Plateau Tract. The whole of the plateau forms one distinct region characterized by an essentially similar agricultural pattern throughout, namely rice in the valleys and on the terraced slopes, and maize, millets and a crop of oilseeds on the uplands. Such differences as exist are merely of degree and not of kind.

40. The Scientific Basis of Geographic Regionalism.

MANORANJAN CHAUDHURI, Calcutta.

Geographic regionalism is a definite remedy for many of our socioeconomic evils. The region is the unit area formed by aboriginal conditions of geological structure, climate, animal and plant life, reformed and partly re-defined by man according to his needs. Problems to be considered in regional planning include agriculture, drainage-basin development, land-use, soil-conservation, forming of new urban and industrial complexes and development of transporation facilities.

Regionalism is a dynamic concept. The type and extent of the region will depend upon the nature of its ties, that is whether the limits are primarily geographic or whether it is unified by economic resources or services, political organisation or racial affinities. A geographic region, thus may include within it a number of cultural and racial regions. The boundaries between regions are never graded; facts of human inter-course making them easier and accessible. Applied in a wider sense, regionalism has meant quite different things in different countries. Regional movement has meant economic cultural and political changes. Industrial planning presupposes regional planning. Among the examples of such regional planning bodies are the New England Regional Planning Commission, the Pacific North-west Regional Planning Commission and the Tennessee Valley Authority. The 21 economic regions (oblastis) of the Soviet Union are examples of scientific regional intergration of the country in place of 93 old provinces.

Regionalism is not sectionalism or separatism. The growth of the dynamic region signifies only the development of human relationship across the cultural, ideological and ethnic frontiers. In fact, it is the only important task for the present generation. A region-conscious world would avoid strifes and feuds and would automatically head toward a stable world organisation. The causes of conflicts among peoples is due to the fact that the process of political unification has taken place in generous disregard of geographic economic realities. Geographic regionalism applied in India would mean a total change in the economic and cultural landscape of the country. The paper, in a nutshell, discusses the theory of regionalism and reviews the recent trends of regional movement in different countries.

41. "The Rupnarayan Basin—A study in Riverine Geography".

PARBATI KUMAR SIRCAR, Calcutta.

The present paper is a regional study of the Rupnarayan Basin based on original field observations, correlating the distribution of physical and human phenomena The Rupnarayan Basin, has been taken here to mean the natural basin of the Rupnarayan, excluding, however, the basins of the rivers, Silai and Dwarakeswar, which combine to form the Rupnarayan. Next to the Damodar, the Rupnarayan is the most important and problematic river of West Bengal, dominating the land and life of greater parts of the districts of Bankura, Midnapore, Hooghly and Howrah. The physical phenomena include a study of the hydrographic, climatic and edaphic environments, while the human phenomena embrace an interpretation of the occupation of the region and the distribution of population. The changing pattern of land utilisation through the last half century or so and the resulting shift in the populauion centres of gravity points to the regional disbalance of man and this on analysis proves to be due to the gradual decadence of the Rupnarayan. Congestion in the Silai and the Dwarakeswar and the uncontrolled discharge of the Damodar through its spill channels into the Rupnarayan bring in severe floods with roughly a three-year interval. The disturbance in the smooth river regime has all the more expedited due to human interference and a widespread maladjustment has set in between the soil and the sons of the soil. Hence solution of the problems facing the farmer lies in the solution of the river problem, by introducing the modern methods of river training.

42. The Godavari Basin—A geographical analysis.

K. BAGCHI and S. DAS-GUPTA, Calcutta.

The paper analyses the geomorphic and hydrological elements of the Godavari Basin. The resource-potentiality of the area has also been assessed. Particular attention has been given to the scope and possibility of the multi-purpose development of the Godavari river. The paper is profusely illustrated with cartograms, maps and blocks.

43. A Regional Survey of Shahabad District.

R. P. SINGH, Ranchi.

The paper deals with the regional survey of the district of Shahabad which is enclosed by the Rohtas hills in the south and the rivers Ganges, Sone, and Karamnasa on the other three sides. The district falls into four regions; the Hethar or lowland, Denar Bharki or the land between the Chausa canal and the Karamnasa, Dakhin or south, and the Pathar or plateau. The relief features of the district, its soils, climate, crop production, and distribution of population have been fully discussed in relation to human occupation. The problem of better utilisation of the land and prospects of industries have also been discussed.

SECTION OF BOTANY

PRESIDENT: M. S. RANDHAWA, M.Sc., I.C.S., F.N.I.

Cryptogamic Botany and Plant Pathology

1. Sea-weeds of Baroda Coast.

S. T. MOSES, Baroda and T. V. R. PILLAY, Okha.

Sea-weeds are abundant in Okhamandal and Kodinar areas of the Baroda State. Experiments in the past to a wrong assessment of sea-weed economics due apparently to mistimed visits, for weeds which are in profusion and in bloom in December and January die and disappear by July or even June. Occurrence of the edible sea-weed *Ulva lactuca* and useful algae like *Gelidium, Gracillaria* and *Sargassum* prove the economic possibilities of the investigation of sea-weeds of the coast. For even *Zostera* the abundant seagrass, use is found today elsewhere, in these days of refrigeration. The ecological set-up of the various genera and species is given with some details of habitat. So far 35 genera and 48 species were identified. Among these are included 3 species of Phanerogams. The work is proceeding. A check list is given:—*Microcoleus, Enteromorpha, Udotea, Caulerpa, Ulva, Halimeda, Amphiroa, Acetabularia, Codium, Padina, Sargassum Dictyota, Dictyopteris, Ectocarpus, Hydroclathrus, Colpomenia, Leathesia, Meristotheca, Chrysomenia, Gelidium, Gracillaria, Hypnea, Leveiella, Rhodymenia, Nitophyllum, Polysiphonia, Champia, Laurencia, Cryptomenia, Chondria, Corralline, Lithothamnium, Helophila, Cymodocea and Zostera.*

2. A Choanephora disease of *Dolichos Lablab.* L.

Q. A. AHMED, Dacca.

An undetermined species of *Choanephora* was observed by the writer in the University Botanical Garden, Dacca, on *Dolichos lablab* causing a dry rot and ultimate shedding of the leaf after reducing it to a blackish crumpled mass.

The fungus was observed in the later part of August and at the time of writing (21. 10. 48) is still continuing growth. On the infected leaf, profuse white stiff conidiophores 2 to 2.5 mm. in length can be seen bearing the black conidia. There is no appreciable enlargement of the primary stalk of the conidiophore at the point of origin of the conidia-bearing branches. Both large and diminutive pendant sporangia have been found to occur along with conidiophores in nature and in culture media. The columella tends to be globose. The sporangiophores are ovoid to fusiform with a cluster of very fine radiating hairs at both ends, but are not striate like the conidia. The conidia are also ovoid to fusiform in shape. Intercalary thick-walled chlamydo-spores are found to occur in culture media. Further work is in progress. The available literature gives no record of the fungus causing a disease on *Dolichos Jablab* in India.

3. Production of Antibiotic Substances in Soil by the Method of Soil Treatment.

Four samples of rich garden soil were treated with the following organic substances and incubated at 30° C for varying periods of time:—Dextrose 0.4%, Peptone 0.25%, Oat straw 2% + $NaNO_3$ 0.2%, Dried blood fertiliser 2%, the figures representing w/w. During incubation, counts of micro-organisms were taken at intervals of 2—4 days and soil solution and extracts (alcoholic and ethereal) were prepared. These were assayed against four test organisms showing marked inhibitory properties, while the controls remained ineffective. The changes in the character of the soil microbial population as a result of treatment probably played an important role in inducing toxic condition in soil.

4. Effect of Tyrothricin on Nitrogen-Fixing (Non-Symbiotic and Symbiotic) Soil Bacteria.

Three strains of *Azotobacter* and five strains of *Rhizobium* were grown at 30°C in N-free mannitol phosphate media containing varying amounts of tyrothricin. The numbers of survivors were determined at intervals varying from 3-24 hours for 4—6 days. It appears from the results obtained that all strains were inhibited initially and that there was specificity of strains amongst susceptible organisms towards the antibiotic substance.

5. A truffle (*Tuber sp.*) from Kodaikanal Hills (Madras).

S. R. Bose, Calcutta.

In August 1948 I received some specimens of truffles from Kodaikanal hills (Madras); the ascocarp is about 4 cm. long and oval-shaped with warty scales on the outer surface; ascospores are brownish, globose with diameter 10-12 μ, spore-wall distinctly warty, ascospores (2-4) lying enclosed within clavate thin walled asci. This *Tuber sp.* in a rare find for India. There is only one previous record of truffle from India, *Tuber indicum* Cke. and Massee in "Himalayan truffle, 1822" listed in 'Fungi of India' by Butler and Bisby; it was collected by Duthie in Mussoorie hills.

6. Horse—hair Fungus from Bengal.

S. R. Bose, Calcutta.

The horse-hair fungus represents the mycelial stage of a *Marasmius* usually named *Marasmius equicrinis* Mull. I have collection of such cords of mycelium from Sunderbans in 1921 and 1925 on leaves and branches of *Heritiera minor* ('Sundri trees), from Chittagong (Chandraghona Kaptai Forest) in 1921 on bark of branches of *Dalbergia sisoo* ('Sisoo' trees), from Berkuda Island, Chilka Lake (Madras) in 1922 on dead and dry leaves, from a forest-area close to Calcutta in 1937 on dead leaves and twigs and from Singapore in 1927 collected by Mr. M. R. Henderson on dead branches and leaves. The Bengal specimens are rhizomorphs of *Marasmius equicrinis* and *M. pangerangensis*, both determined by late Dr. G. Bresadola of Italy. The cords of mycelium are black and tough, they look like black horse-hair. The cords run from branch to branch in forests, hanging in festoons from upper branches and remaining attached to leaves and stem by small brown discs. The whole course is random and aerial. Fructification appears in rainy season on forest beds when the tangled mass of leaves and twigs with the cords happens to fall to the ground. The fungus is not parasitic

but epiphytic, it causes no damage to host trees. Petch has given a detailed description of the fungus with figures in his book on The Diseases of the Tea Bush, 1923, pp. 83-85. The fungus grows on various shrubs and trees in the forests. It is common in the eastern tropics. Recently (F. J. Seaver, *Mycologia Vol.* 36, 1944) it has been reported from North America, Louisiana, scrub oak forest near S. W. Evans, the hanging cords were encountered by American soilders during their manoeuvres; they used the black cords for sewing buttons on coats and overcoats.

7. Some common ferns of the Darjeeling District.

K. Biswas and Surinder Singh, Sibpur.

The present paper contains descriptive account and observations on the ecology and altitudinal distribution of some of the common ferns of the Darjeeling District. The study is restricted at present to some 50 common species occurring between the elevation of about 4,000 and 12,000 feet.

8. The structure and life history of *Anisogonium esculentum* Presl.

T. S. Mahabale and Tripiti Biswas, Bombay.

Anisogonium esculentum Presl. is an interesting Asplenoid fern growing profusely as a semiaquatic or terrestrial plant in marshy places and fields below waterfalls at Mahabaleshwar and other places in the Bombay Presidency. The anatomy of this species has been worked out which in general agrees with that of Asplenoid ferns in having a dictyostelic rhizome, leaf trace with two strap-shaped bundles etc. The stolon shows a broad more or less semicircular siphonostele, protoxylem lying at the two ends of the core. The most important feature of the plant is a variety of the ways in which it reproduces vegetatively by the formation of stolons, buds arising in the axils of leaflets and rachis, margin of pinnules and on roots.

A study of the different modes of vegetative propagation and structures involved in them is in progress.

The spores germinate in about 6-7 days form prothalli in 1½ months in culture. The prothalli are multilobed, irregular, small, 0.1—0.2 cm. in diameter showing varied behaviour in germination. Their development and adult form generally resemble those of *Actiniopteris,* but mostly they are without any cushion. There is a plurality of meristematic cells at the margin resulting in multilobed structure lying in more or less the same horizontal plane. The antheridia are normal. Some of the cells at the lower end of the prothallus show collenchymatous thickenings. No archegonia have so far been noticed even in large fully formed prothalli.

9. Prothallus of *Lygodium flexuosum* Bedd.

T. S. Mahabale and N. Kulkarani, Bombay.

Two species of *Lygodium* namely, *L. flexuosum* Bedd. and *L. microphyllum* R. Br. are found in the Bombay Presidency, the former being commoner than the latter.

The studies on the germination of spores revealed that the spores are viable as soon as they are formed and germinate in a normal way. They are viable for about 6 to 8 months.

The adult prothallus of *Lygodium flexuosum,* growing wild in nature, is a large, broadly cordate (breadth varying from about 4 mms. to 1.2 cm.), thin and delicate structure having more or less symmetrical lobes. The apical notch is very narrow and prominent. In most of the cases the two lobes of the prothallus overlap each

other at the anterior end, leaving a small unoverlapped portion towards the centre. The margin is entire. The cushion is thick and prominent—the thickness being about 1 to 2 mm. On the posterior part of the cushion are many unicellular smooth rhizoids.

The cells of the prothallus are large, closely packed, hexagonal with their longer axes elongated in the radial direction. Each cell is full of protoplasm having numerous chloroplasts. About 2 to 3 layers of cells below the margin are irregular and have wavy cell walls. Curiously enough a few club-shaped unicellular glandular hairs pointed towards the apex of the prothallus are noticeable on the margins of lobes, especially towards the anterior side. The prothallus is bisexual bearing archegonia on the cushion and the antheridia on the lateral sides and its posterior part, mixed with the rhizoids. Each archegonium is embedded in the tissue of the thallus, with its neck slightly protruding. The antheridia which are even found to be present on the thallus after fertilization, dehisce by the overthrow of a small circular opercular cell as in other Schizaeaceae.

The sporophyte arises from any part of the cushion and forms the first leaf which is not lobed. The young embryonic leaf is covered with two-celled hairs not very different from those on the prothallus. Studies on the development of the spores and embryo are in progress in the two species.

10. Prothalli of *Cheilanthes farinosa* Kaulf. and *Tenuifolia* Sw.

T. S. Mahabale and J. J. Shah, Bombay.

Cheilanthes is an important member of the advanced Gymnogrammoid ferns and is represented by ten species in India of which three occur in the Bombay Presidency. They are all xerophytes-highly specialised in their anatomical structure. The exact affinities of the genus are uncertain, its nearest relative being considered to be *Gymnogramme* by some, *Pellaea* and *Notholaena* by others and *Adiantum* by still others. The reasons for this variety of opinions lie in its morphological features such as scales and glands as those in *Pellaea* and *Notholaena,* the solenostelic rhizome, waxy coating and acrostichoid dissolution of the sorus as in *Gymnogramme,* and the submarginal semicircular sporangia seated on distal ends of veins protected by recurved leaf-margin as in *Adiantum.* In view of these diverse characters it was thought worth-while to investigate the prothalli of *Cheilanthes farinosa* and *tenuifolia* Sw. growing wild in Bombay Island. The spores were successfully germinated in the latter species but not in the former. Prothalli of both were obtained in nature.

The adult prothalli of *C. farinosa* are fairly large, cordate, the notch being deep at both the ends. They are dark green, 0.3 to 1 cm. in diameter. The cushion is thick and produces tubers should there be no fertilization, by the prolongation of the anterior end. Such prothalli are generally perennial, large and stout. The archegonia are scattered over the tuberous swelling of the cushion or its prolongation. The sporophyte is formed near the anterior end. The embryonic leaf is simple and bears numerous wax glands characteristic of the species. In shape, appearance and perennation the prothallus greatly resembles those of species of *Anogramma, Gymnogramme* and liverworts like *Fossombronia.* In some large prothalli multicellular, brown, scales were seen arising on buds below meristem strongly indicating apogamy.

The prothalli of *C. tenuifolia* grow on hard barren rocks at Sion near Bombay. They are also cordate but not deeply notched. They are 0.2—0.3 cm, in diameter and dark in colour. The cushion is small and elongated. The lobes stand more or less erect in their natural habitat. The archegonia are formed at the anterior end of the cushion, the antheridia spreading on the posterior part.

The spores germinated in about 10 days and formed prothalli. On the basis of the prothallial characters the genus seems to be a near relative of *Gymnogramme* and *Adiantum*.

11. Prothallus in the genus *Nephrolepis*.

T. S. MAHABALE and S. R. JAVALGEKAR, Bombay.

A study of the sporogenesis in *Nephrolepis exaltata, volubilis* and *acuta* by one of us (T.S.M.) and Gorji revealed that there are 42 chromosomes in *N. exaltata* and that there are no deviations from the normal cytogenesis in these species. A natural corollary to this was to study the behaviour of spores in culture and to get the prothalli. Several attempts to germinate the spores in *N. exaltata* however failed under laboratory conditions but succeeded in *N. acuta* and the prothalli were formed. The prothalli are 1.5—2 cm. in diameter, thin, and cordately lobed, the lobes being more flattened than in a typical heart-shaped prothallus. They bear numerous reproductive organs generally on the same prothallus but in some only antheridia appear in culture. Two remarkable features of these prothalli are: (1) the presence of small hairs on the margin and on the upper surface, similar to those noticeable on the young leaves of the vegetative buds arising aposporically in the place of sporangia; (2) antheridia borne on a number of filaments emerging from the marginal region of the prothallus in small prothalli.

The antheridia are of the normal polypodiaceous type spread over the lobes of the prothallus.

Although no prothalli were obtained in culture in *N. exaltata* they were obtained this year on Sion hills near Bombay where the species grows wild. These also are typically cordate, bear both antheridia and archegonia in the usual manner but the cushion is very small. The young sporophyte has a bilobed leaf with highly conspicuous hydathodes and clavate hairs. This confirmed the earlier expectation about finding the prothalli of this species.

Prothalli in a third species *N. paucifrondosa* d'Alm. which is endemic in the Western Ghats were obtained growing epiphytically in the pockets of soils on trees on which the species grows. The prothallus is cordate, about 0.2 cm. in diameter with flat thin lobes, but is extremely delicate and transparent.

12. On a new species of *Pucciniastrum* from India.

J. SEN, Calcutta.

A new species of leaf rust which belongs to the genus *Pucciniastrum* Otth. was found widely affecting *Abies pindrow* Brandis in Kulu Valley. The material under investigation was collected between January and February, 1947. The leaves are seriously affected and as such heavy damages may be expected. Pycnial, and telial stages are not present. The aecidia are somewhat erumpent, small and numerous on the leaves. Peridium delicate forming compact cyst-like units. Spores hyaline, smooth and thin-walled, usually rounded, sometimes ellipsoidal, measuring 5-7 μ

In India the species of *Pucciniastrum* chiefly occur on broad-leaved species. This *Pucciniastrum* therefore is not only a new species but has also acquired a new host in India. But *P. goeppertianum* (J. Kuhn) Kleb. and *P. pustulatum* (Pers.) Diet. have already been reported to occur on *Abies* in America.

The author desires to thank Mr. H. P. Pande for the material and Dr. George B. Cummins for helpful suggestions.

Phanerogamic, Taxonomic and Geographical Botany

13. The Flora of Pareshnath and the neighbouring hills.

K. Biswas and M. A. Sampath Kumaran, Sibpur.

Sufficient information is available on the vegetation of the Pareshnath Hills but a few interesting plants which form what may be termed as a more less relic vegetation on the summit of this highest mountain bordering Bengal and Bihar, bear a striking similarity to some of the plants found at similar elevation over the Sikkim Darjeeling Himalaya.

The geographical position of the Pareshnath range, their geology and climatological data recorded from time to time by various workers have thrown some light on the question of vegetational affinity with the sub-Himalayan regions.

The authors have discussed the floristics of this interesting group of vegetation in the light of their field studies, examination of herbarium materials and existing accumulated data.

14. The Indian Dioscoreas and their importance on dietary.

K. Biswas and M. A. Sampath Kumaran, Sibpur.

Tubers of the edible Dioscoreas are used as food for centuries in the East. In the voluminous monograph, "An account of the genus Dioscoreas in the East" Parts I & II by David Prain and I. H. Burkill (published in the *Annals of the Royal Botanic Garden,* Calcutta, *Vol. XIV,* 1936 & 1939) the Indian Dioscoreas have been dealt with in a masterly way. The authors, however, consider that there exist further scope of more detailed studies on the edible Indian species of Dioscoreas from systematic, ecological, nutritive and horticultural aspects. Durign these days of scarcity of food all possible sources for increasing human diet needs careful examination and the authors hope, the information contained in their paper will have considerable bearing on the problem of "Grow More Food".

15. Notes on the distribution and systematic position of Indian *Diptero-Carpus.*

K. Biswas and P. V. Bole, Sibpur.

The Indian *Dipterocarpus* do not seem to have received the attention it deserves either by foresters or botanists. In the present paper the systematic, the taxonomy, the ecology, the distribution and the economic importance of the species under this genus have been treated. There are 73 authentic species recorded. Of these, the east claims 23 only. Of these again, 2 occur in South India, 5 in Ceylon and 16 in the Lower Bengal extending down to South Burma where the *Dipterocarpus* forms one of the important constituents of the trees forming the overhead canopy in the rain forests.

16. The embryo sac of Podostemaceae.

B. A. Razi, Bangalore.

Several authors, Magnus, Went, Chiarugi and Hammond have demonstrated a reduced Allium-type of embryo sac development in many members of Podostemaceae. The work of Magnus being subjected to much criticism by Maheshwari, the present writer investigated two members of the Podostemaceae, *Lawia zeylanica* and *Griffithella Hookeriana.*

Usually the megaspore mother cell forms a dyad. The upper dyad degenerates and the lower acts as the embryo sac mother cell. The nucleus of this embryo sac mother cell undergoes three divisions before the embryo sac is organised. Degeneration of the chalazal end may start even during the first division or immediately after it, or during the second division of the primary embryo sac nucleus.

The primary chalazal nucleus may divide once, in which case the mature embryo sac will be 6-nucleate as in *Lawia* (Razi, *in press*); or it may persist without division, in which case the mature embryo sac will be five nucleate, as in *Lawia* (Razi), and *Mourera fluviatilis* (Went); or it may degenerate as happens in a majority of cases (*Lawia, Griffithella, Podostemon ceratophyllum, Podostemon subulatus, Hydrobrium olivaceum, Farmeria metzgerioides, Weddelina squamulosa, Apinagia* etc.) to result in a tetranucleate embryo sac. All these tetranucleate embryo sacs have during their development an ephemeral primary chalazal nucleus, and as such can be said to be ontogenetically pentanucleate. Their ontogeny precludes them joining the tetranucleate category, and they are not typically Allium-type. Therefore all such cases are proposed to be brought under the "Podostemon-form of the Allium-type" of embryo sac development.

In some cases, a primary antipodal cell is got at what is normally the two-nucleate embryo sac stage. This rare feature has also been seen in *Butomopsis lanceolata* and *Hydrocharis emarginata* by Johri.

One more peculiarity is the development of a short lived *upper polar cell* in *Griffithella Hookeriana* (Razi, *in press*). A similar stage has been drawn by Magnus for *Podostemon subulatus*.

The lower end of the embryo sac becomes continuous with the pseudo-embryo sac by the dissolution of the intervening wall in *Lawia* and *Griffithella*. This caecum acts as a haustorial organ during early embryogeny.

17. The Embryo sac of *Chrysanthemum parthenium* L. (Bernh).

P. Maheshwari and Ashraful Haque, Dacca.

The species has already been investigated by two Swedish workers, namely Palm and Fagerlind. As both the accounts differ in some ways, a reinvestigation was thought to be desirable.

The present material was collected by one of us from the Brooklyn Botanic Garden, New York.

The ovule is unitegmic and tenuinucellate. The hypodermal archesporial cell functions directly as the megaspore mother cell and is often mounted on two or three axial cells of the nucleus. The two meiotic division proceed normally and result in the formation of the four megaspore nuclei. No appreciable difference could be noticed in the sizes of the nuclei as reported by Fagerlind, nor are there any nuclear fusions, although in certain cases the two central megaspore nuclei were found in close contact with each other. The eight nuclei of the next stage lie in four pairs, each pair being separated from the next by a vacuole. Preparatory to the last division, the micropylar pair of nuclei becomes further removed from the remaining three pairs by an increase in the volume of the vacuole between the first and the second pair of nuclei. The next stage shows 16 nuclei, 4 at the micropylar and 12 at the chalazal. These organise to form a three celled egg apparatus, two polar nuclei and 11 antipodal cells all of which are usually uninucleate. In contrast with the observations of Palm and Fagerlind, basal antipodal cell never shows more than one nucleus. Nor does it differ appreciably from the other antipodal cells in size. But sometimes one or the other of the remaining antipodal cells may be binucleate. Eventually all of the antipodals degenerate forming a dark streak which is absorbed during later development.

It was noted that as in other Compositeae, the nucellar epidermis disorganises during the development of the embryo sac and the innermost layer of the integument becomes differentiated as the endothelium. A peculiar feature is that most of the cells of the anther-tapetum degenerate *in situ* and only a few protrude inside into the anther loculus. A true periplasmodium was never seen in our material.

18. The Embryology of *Ottelia alismoides* Pers.

AHMAD SHAMSUL ISLAM, Dacca.

Ottelia alismoides flowers abunduntly at Dacca during the months of September and October. The present work was undertaken to check and enlarge upon the findings of S. K. Narasimha Murthy who studied the embryology of this species in 1935.

The pollen grains are spherical with spiny projections all over the exine. At the shedding stage they show a crescent-shaped generative cell and a spherical vegetative nucleus.

The primary archesporial cell does not function directly as megaspore mother cell. In all cases a parietal cell is cut off. After the first meiotic division of the megaspore mother cell the chalazal dyad cell alone divides again resulting in a row of three cells. The functioning megaspore undergoes three divisions to produce a normal eight-nucleate embryo sac.

The pollen tube does not disappear after fertilisation and is traceable even in the ovules with well-developed embryos. Another peculiar and interesting feature is the occurrence of pollen grains inside the ovary as have also been reported in *Butomopsis lanceolata* and *Erythronium americanum* by Johri and Haque respectively.

The endosperm is of the Helobial type. Contrary to the observations of Narasimha Murthy, the chalazal chamber is much smaller than micropylar and as a rule its nucleus remains undivided.

The development of the embryo is of the Sagittaria type. The basal cell becomes much enlarged and vesicular and can be recognised even in fully mature embryos.

19. The development of the female gametophyte and endosperm in *Moniera Hamiltoniana* T. Cooke.

K. M. SAFIULLA and H. C. GOVINDU, Bangalore.

The ovary in *Moniera Hamiltoniana* T. Cooke. is superior and bilocular with many unitegmic anatropous ovules borne on a massive axile placenta. The hypodermal archesporium directly functions as the megaspore mother cell. Megasporogenesis proceeds normally and the embryo sac is developed according to the normal or *Polygonum* type. Sometimes a T-shaped tetrad is met with. The innermost layer of the integument forms the endothelium or the integumentary tapetum and it functions as a nutritive layer.

In the mature embryo sac the synergids are elongated and show characteristic nooks. The egg is pear shaped and lies in between the synergids. The antipodal cells degenerate early. Starch grains are usually present in the mature embryo sac and sometimes even at the megaspore tetrad stage.

Endosperm development is *ab initio* cellular. Two types are noticed in the early development of the endosperm. It develops haustoria at either ends. The micropylar haustorium, is four celled, each cell uninucleate. It is more aggressive than the chalazal haustorium and persists up to a late stage in the seed. The chalazal haustorium is uninucleate and is very aggressive to begin with but disappears during the later stages

of the seed. Endosperm tissue is situated between the two haustoria and it shows prominent nuclei and plenty of nutritive contents which take up a deep stain. The epidermal layer of the seed coat develop prominent thickenings on its outer wall.

20. A note on the development of the endosperm in *Stylidium graminifolium* Swartz.

K. Subramanyam, Bangalore.

Stylidium graminifolium Swartz is a member of the family *Stylidiaceae* and materials of this plant, for the present study were available from New South Wales, Australia.

After double fertilisation, the primary endosperm nucleus which is situated in the upper region of the embryo sac divides. This is followed by the laying down of a transverse wall resulting in a primary micropylar and a primary chalazal chamber. A vertical wall is then laid down in the primary micropylar chamber followed by a similar wall in the primary chalazal chamber. The endosperm is now made up of four cells, with two cells in each tier.

Next, transverse walls are formed in each of the tiers of the four-celled endosperm. First, a transverse division occurs in the upper tier of cells and this is soon followed by a similar division in the lower tier; the result is an eight celled endosperm made of four tiers of two cells each as in certain members of the closely allied family Lobeliaceae.

At the eight-celled stage of the endosperm, the two cells of the upper tier develop into the micropylar haustorium and of the lower into the chalazal haustorium. The two middle tiers form the main body of the endosperm. Thus the sequence of wall formation closely corresponds to the Scutellaria type of Schnarf. A similar sequence has been reported by Rosen for *Stylidium adnatum* and is also seen in the different species of *Lobelia*, a genus of the closely allied family Lobeliaceae.

21. The problem of the conservatism of the Vascular Bundles.

A. C. Joshi, Hoshiarpur and V. S. Rao, Delhi.

While it has been generally believed for a long time that the vascular bundles are conservative and tend to persist after the organ which they previously supplied has disappeared, Arber some years ago strongly challenged this assumption. The study of the floral anatomy of approximately 4 dozen species of Acanthaceae provides interesting evidence bearing on this problem. This family shows progressive reduction in the androecium. Some forms have four functional stamens and a staminode; some, four functional stamens only; some, two functional stamens and two staminodes; and others, only two functional stamens. In *Ruellia tuberosa* Linn., *Barleria prionites* Linn., *B. cristata* Linn., and *B. strigosa Willd.*, which have an androecium of four stamens and a staminode, five staminal traces enter the corolla tube, one of which is small and supplies the staminode. In *Hemigraphis colorata* Hallier f. and *Strobilanthes callosus* Nees, which also possess four functional stamens and a small staminode, there is a staminodal bundle but this runs only in the corolla tube and fades away before reaching the base of the staminode. In *Hygrophila serphyllum* T. Anders, *Asteracantha longifolia* Nees, *Rullia cernua* Roxb., *Barleria lupulina* Lindl., *Blepharis boerhavifolia* Pers, and *Aphelandra pectinata* Wild. ex Nees, the androecium consists of only 4 stamens. There is no staminode. Still, there is a vascular bundle present for the missing staminode. It runs in the corolla tube nearly upto the level of insertion of the stamens. In *Thunbergia fragrans* Roxb., *T. grandiflora* Roxb., and *Crossandra undulaefolia* Salisb., the position is similar except that the trace for the missing staminode runs in the corolla

tube much above the level of insertion of the stamens. In *Sanchezia nobilis* Hook. f., a staminode is present, although very greatly reduced, yet there is no vascular supply for it, and the staminodal trace is completely suppressed.

Thus we see that the vascular bundles show considerable variety in their relation to the degenerating organs. Sometimes they disappear before the organ has completely disappeared, while in other cases they presist after the organ which they supplied has ceased to exist. This conclusion agrees with that of Bechtel, based on the study of Urticales, and should be noted when attempt is made to elucidate the morphology of any floral part with the help of anatomical evidence.

22. The Origin and Development of Stipules in *Morus alba* Linn.

G. P. Majumdar and G. C. Mitra, Calcutta.

Cross (1937) has already published an account on this subject, but as his findings are fundamentally different from the accepted position re-investigation of the problem with local material was undertaken.

According to Cross (1) stipular primordia originate by suppression of growth at two points on opposite sides of apex of a primordium (base) when 70 μ high and before the lateral trace bundles differentiate in the latter, (2) lateral trace bundles originate in the base and then differentiate basifugally in the primordium and basipetally to join the axial ring, (3) the stipular traces originate at the base of the stipular primordia and then make their connection with the laterals; they are not branches of the latter. He even suggests that "the stipules are....products of the closely adjacent *cauline tissue* which has diverged slightly at the node in adjustment of leaf production. The diverged portion of the node might then be considered a leaf-stem transition region."

Our studies of the local material of the same species on the other hand support the accepted Leaf-base Divergence Theory of the origin of stipules under the influence of branches from the laterals of a three bundle trace. The non-contiguity of the leaf and stipule scars which "are separated by appreciable nodal areas,' and which prompted Cross to suggest an alternative interpretation of the origin of stipules as noted above has been explained. Other points raised by Cross have also been criticised in the light of the data at the disposal of the authors.

23. Some abnormalities in the inflorescences of *Saccolepis myosuroides*. A Camus and *S. interrupta* Stapf.

Reayat Khan, Dacca.

The phenomenon of "vivipary" (used in Mattfeld's (1820) and Engler's (1826) sense to denote cases in which bulbils develop in the inflorescence and sometimes germinate on the parent plant), is well-known in some genera of the Gramineae, *e.g., Deschampsia, Festuca, Poa* etc. but has apparently not been recorded in *Saccolepis*. The specimens on which this study is based were collected from places in the Chittagong and Dacca districts and are deposited in the Herbarium of the Dacca University.

The normal inflorescence in *S.myosuroides* and *S. interrupta* is a cylindrical spike-like panicle in which the rachis is furrowed and bears small pedicellate spikelets in little fascicles. The viviparous inflorescences are conspicuous by the presence of one or more vegetative shoots projecting from the rachis. They are borne in the position of the spikelets on greatly elongated pedicels and consist of several leafy structures resembling large sized bracts some of which may be ligulate. In some cases an axis bearing a few spikelets was seen to protrude out from amongst the leafy structures.

In some specimens of *S. myosuroides* the abnormal inflorescences become divisible into two or three distinct parts separated by naked areas of considerable length. Each part consists of an involucre of several conspicuous bracts and from amonst these arise shoots of both kinds, vegetative as well as reproductive, the latter bearing only a small number of spikelets.

Since only Herbarium specimens were available it is not possible at the present moment to determine whether these abnormal shoots can act as propagules or bulbils but their appearance strongly suggests that this is not very unlikely. The work is being continued further.

24. The Embryo sac of *Erythronium americanum.*

Ashraful Haque, Dacca.

The genus *Erythronium* belongs to the family Liliaceae, sub-family Lilioideae and tribe Tulipeae. In all it comprises 19 species of which 17 occur in North America, one in Japan and one in Eurasia.

Material of *E. americanum* was obtained through the courtesy of Dr. H. W. Bannan of the University of Toronto.

The ovary is trilocular, each loculus containing two rows of anatropous, bitegmic ovules.

One of the hypodermal cells of the nucellus becomes differentiated as a primary archesporial cell, which soon increases in size and becomes two to three times as long as broad. This functions directly as the megaspore mother cell. Only three divisions intervene between this stage and the mature embryo sac, and the development is, therefore, of the Adoxa type. The phragmoplasts between the dividing nuclei often persist for a long time and occasionally the spindles of the second division were found to persist along with those of the first division.

In some four-nucleate embryo-sacs the nuclei showed a 1+3 arrangement instead of the usual 2+2. In others, the two chalazal nuclei were much larger than the two micropylar ones. Several eight-nucleate sacs were also met with in which the four micropylar nuclei were much smaller than the four chalazal ones. These three features suggest that, occasionally, the development is of the Fritillaria type. Further a few sacs were observed in which the micropylar end had the usual four nuclei whereas the chalazal end showed only two nuclei which were however of a much larger size. This can be interpreted as a reduced form of the Fritillaria type in which the last division failed to occur at the chalazal end of the embryo-sac.

The pollen grains show a spherical or a crescent-shaped generative cell and an irregularly shaped vegetative nucleus. An interesting feature is the frequent occurrence of pollen grains inside the ovary, one slide alone showing about one hundred and thirtyfive pollen grains in this position.

The chromosome number is $n = 24$ and $2n = 48$. This is based on counts made from the dividing megaspore mother cells and the last division of the nuclei in the embryo sac.

25. Contributions to the embryology of the Liliaceae I. *Gloriosa superba.*

A. M. Eunus, Dacca.

The material for study was collected from the Botanical Garden of the Dacca University and from the Government Nursery, Dacca.

The flowers showed two or three sterile stamens partially or completely enclosed inside the ovary, the remaining stamens being quite normal.

The anther is tetralocular. During early stages the distinction between sporogenous cells and parietal cells is not sharp. In later stages the microspore mother cells are surrounded by a tapetum, four to six middle layer show well-developed fibrous thickenings. The tapetal cells remain uninucleate. The divisions of microspore mother cells are successive and the tetrads are usually of isobilateral type although sometimes they may be tetrahedral. The pollen grains are two-celled at the time of shedding.

The ovule is anatropous and bitegmic, both the integuments taking part in the formation of the micropyle. In early stages the nucellus is long and slender. There is a single hypodermal archesporial cell which directly functions as the megaspore mother cell and undergoes the usual meiotic divisions to form a linear tetrad of megaspores. Generally the lowest or chalazal megaspore functions but frequently it is the third and rarely the uppermost. Occasionally two megaspores begin to grow concurrently. The embryo sac is of the usual eight-nucleate type. The antipodal cells become binucleate.

The endosperm is of the Nuclear type.

26. Contributions to the embryology of the Liliaceae II. *Albuca Transvalensis* Moss-Verdoorn.

A. M. Eunus, Dacca.

Material of this plant was obtained from South Africa through the courtesy of Dr. S. Krupko of the University of Johannesburg. Only stages in megasporogensis and development of embryo sac and endosperm were available.

The ovule is anatropous and bitegmic. The inner integument forms the micropyle and in later stages its swollen tips form a sort of lid or operculum lying just above the embryo sac. A cross section of the ovary shows conspicuous septal glands. At the base of the funiculus there is a mound of swollen and glandular cells which seem to function as an obturator. Usually the nucellus shows a single hypodermal archesporial cell but in some cases two or three archesporial cell have been seen. The archesporial cell divides to produce a megaspore mother cell and a wall cell. Two wall layers are found over the embryo sac but they degenerate and disappear when the embryo sac reaches maturity. The micropylar cells of the nucellar epidermis become markedly elongated and until the time of fertilization, their nuclei are situated towards upper tangential walls but later they move near the lower tangential walls. Both T-shaped and linear tetrads are formed. The chalazal megaspore functions and gives rise to normally organised eight-nucleate embryo sac. The synergids are peculiar in that the nucleus lies towards the lower end or the cell and a vacuole occupies the upper end, which is the reverse of the usual condition. One of the synergids always persists until some time after fertilization.

The endosperm is of the Helobial type and the chalazal chamber shows about half a dozen nuclei.

27. The embryology of *Juncus prismatocarpus* Br. and *J. effusus Linn.*

B. Zaman, Dacca.

Material of these two species of *Juncus* was obtained from Shillong. The ovary is tricarpellary and unilocular, and bears 3 parietal placentae. It contains an indefinite number of anatropus ovules arranged in two rows on each placenta. The inner surface of the perianth lobes is heavily lignified; stomata are borne on the outer surface only. The style is hollow with a triradiate lacuna.

The microspore mother cells are surrounded by the uninucleate cells of tapetum, two layers of parietal cells, the endothecium, and the epidermis. The pollen grains are united in tetrads. The generative cell is cut off towards the inner end of each cell of the tetrad, but it soon moves from its original position and lies free in the vegetative cytoplasm where it divides to form the two male gemetes.

The ovules are bitegmic. Each of the integuments is two-layered. A hypodermal cell of the nucellus becomes differentiated as the primary archesporial cell which divides to form a parietal cell and the megaspore mother cell. This undergos the usual meiotic divisions to form an axial row of four megaspores of which the innermost functions and the other three degenerate. The development of the embryo sac is of the Polygonum type.

The endosperm is of the Helobial type. The nucleus of the chalazal chamber divides only once but several free nuclear divisions take place in the upper chamber followed by wall formation. In the mature seed the endosperm cells seemed to lack any functional nucleus.

28. A revision of the Indo-Malayan Species of *Chonemorpha* G. Don.

R. Seshagiri Rao, Cocanada.*

The confusion in the synonymy of some of the species of the genus, the doubtful points raised in Dr. Chatterjee's paper on "the genus *Chonemorpha* G. Don" published in *Kew Bullentin*, No. 1. (1947) and the recent addition of a new species, have necessitated further clarification and revision of the genus.

The genus is mainly confined to tropical and sub-tropical zones of India, Burma, Malaya, Peninsula, Malayan Archipelago, Siam, Annam and China. There are 14 species recorded so far, of which India claims 4 species and the Malayan region, 2 species.

Chonemorpha fragrans (Moon) Alston based on the earlier name *Echites fragrans* Moon (1824) is the valid name and not *Chonemorpha macrophylla* (Roxb.) G. Don which is based on *Echites macrophylla* Roxb. (1832), a nomen nudum. As per homonym rule, *Chonemorpha blancoi* Merr. but not *Chonemorpha elliptica* (Blanco) Merrill et Rolfe, is the valid name. *Chonemorpha pedicellata* Seshagirirao Sp. Nov. is typically distinct by the presence of long pedicels, peduncle and long finely pubescent calyx with conical lobes.

A synoptical key to the species, illustrated specific descriptions with additional notes on distribution, discussions on points of validity, synonymy, references to literature and citations of herbarium specmens are given in the paper.

29. Occurrence of *Paragrewia* Gagnep. in India and Burma.

R. Seshagiri Rao, Cocanada.

In 1945, Gagnepain published a new genus, *Paragrewia*, the type of which is *Paragrewia poilanei* Gagnep. collected from Annam. During the study of the Indo-Burmese Species of *Grewia*, a few doubtful specimens of the Calcutta and Madras Herbaria collected from Salween (Burma) and Tinnevelly, (S. India) have been examined and identified as *Paragrewia poilanei* Gagnep.

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*This work was done at the Herbarium, Royal Botanic Garden, Sibpur.

Paragrewia resemble *Grewia* in habit, general form of leaf and structure of ovary but differs from *Grewia* by the absence of androgynophore and also of glandular depression at the inner base of petals and by the presence of limited number of stamens, namely, 15.

The distribution of *Paragrewia* is peculearly discontinuous. The genus has not so far been recorded anywhere between Annam and Burma and between Burma and southern-most part of the Peninsular India.

A detailed illustrated description of the species, citations of herbarium specimens and a brief discussion on the distribution of the species are given in the paper.

30. *Primitivity of the Angiosperms (With special reference to the presence of pollen grains in the stylar canal and ovary of members of the family Butomaceae).*

B. M. JOHRI, Delhi.

The two great groups of plants, the Gymnosperms and the Angiosperms, have long been separated on such old ideas as (*a*) presence or absence of vessels in vegetative parts, (*b*) floral structures, (*c*) pollination and fertilisation and (*d*) gametophytes and embryogeny. The discovery of *Caytonia,* which was formerly supposed to be the first fossil angiospermic type of carpel has definitely been claimed to be gymnospermous on the basis of the further discovery of pollen grains in the micropyles of *C. thomasi, C. sewardi* and *C. nathorsti.*

Thompson's work on *Gnetum* has clearly shown the presence of vessels in its wood which are more or less of the same type as found in angiosperms. The floral structures of some of the apetalae bear close resemblance to flowers of *Ephedra.* The presence of pollen grains in the stylar canal and in the ovary of *Butomopsis* and particularly the germination of the pollen grain on the ovule brings it very close to *Caytonia.* The micro-and megasporogenesis as well as the gametophytes of *Ephedra* and *Gnetum* are closely allied to those of angiosperms.

The concept of foliar origin of angiospermic carpel has received considerable attention during recent years. The carpels with partly open margins and hollow stylar canals as in *Alismaceae* and *Butomaceae* must be regarded as much more primitive than closed carpels with stylar canals completely filled with nutritive tissue. The hollow stylar canal was evidently replaced by nutritive tissue as the stigma became closed.

In 1935 the author made a chance discovery of finding pollen grains in the stylar canal and in the ovary of *Butomopsis lanceolata.* In one case a pollen grain had actually produced a short pollen tube on the surface of the ovule. This work has further been followed up and now pollen grains have been observed in the canals and often in the ovaries of the remaining three members of the family *Butomaceae—Butomus umbellatus, Limnocharis emarginata* and *Hydrocleis nymphoides.* Such a case has not been reported as a normal feature in any other Angiosperms except in some stray cases like *Moringa* where Puri has reported one case of seeing pollen grains in the stylar canal. Such stray cases must be left out of consideration as compared to the normal presence of pollen grains in *Butomaceae.*

Great significance must be attached to this discovery because it does confirm, even if only to a certain extent, the primitivity of the Butomaceae among the Angiosperms and it does lend a great support to the former view of regarding *Caytonia* as an angiospermic form.

Whether the angiosperms are monophyletic or polyphyletic in origin is also a related question which deserves some consideration in this connection. A sum total of all the taxonomical, anatomical, embryological and genetical evidence would support the view that angiosperms are definitely polyphyletic in origin. Just as *Butomaceae* are primitive among the monocots, the *Ranunculaceae* which is closely allied to the *Alismaceae* and *Butomaceae* are primitive among the dictots. Whether monocots are primitive to dicots or vice versa has been a very baffling problem. Conflicting opposite views have been expressed by Engler and Bentham & Hooker. The discovery of *Ranalisma* by Ridley, a plant closely allied to *Ranunculus* and *Alisma* is most interesting but unfortunately not more than one (or two) specimen of this rare plant has been found to undertake its detailed study which might have produced some evidence to decide the primitivity of the monocots and the dicpts. However, it is likely that the *Ranunculaceae* and the *Alismaceae* might have had their origin from a common ancestry represented by forms like *Ranalisma.*

The fossil remains of any angiospermic flower have been most scarce. The only single well preserved specimen of *Sahnianthus* from the Tertiary period of India has been placed in the family *Lythraceae* as has been studied and recorded by its discoverer Dr. Shukla. Although the position of the flower under the Lytthraceae seems somewhat doubtful, it is at once clear that dicots were flourishing during the Tertiary period. The evidence on this score could not be conclusive until after some time when more forms have been discovered.

The problems of primitivity of angiosperms is a fundamental one and interesting in more than one way. Its serious consideration raises more than one baffling problems. The author's present discovery of pollen grains in the stylar canal and ovary of *Butomaceae* place them very near to the gymnosperms and *Caytonia* which has been acclaimed as a gymnosperm can definitely be regarded as a connecting link between the gymnosperms and the primitive angiosperms if it can not be considered as an undisputed angiosperm. We must therefore give a new orientation to our ideas of the distinctions between gymnosperms and angiosperms on which their separation is based.

Cytology and Genetics

31. What determines inequality in size of the male nuclei in the genus *Ephedra?*.

P. N. Mehra, Amritsar.

The formation of the male nuclei by the division of the body cell nucleus has been studied in 6 species of the genus *Ephedra.*

In *E. foliata* and *E. sinia* the two male nuclei are of the same size, in *E. likiagensis* the male nuclei may be equal or unequal but in the latter case there is no marked difference while in *E. altissima, E. intermedia* and *E. saxatilis* they are markedly unequal particularly in the last species.

The inequality where present is due to the hetero-polar nature of spindle of the dividing body nucleus. The spindle half towards the stalk nucleus end is late in appearance, truncate and blunt in contrast to the spindle half on the other side which is converging. The chromosomes when they reach the pole at the blunt end are consequently dispersed and scattered compared to those on the opposite side where they form a compact mass at telophase. The nucleus formed towards the stalk nucleus end, therefore, is invariably bigger than its sister on the other end. There is thus no difference in the amount of chromatin in the two nuclei but there is obviously some in the amount of karyolymph. The two nuclei if unequal, maintain this difference even during their further growth in the pollen tube.

Species which possess unequal male nuclei in the normal haploid pollen grains, exhibit the same difference even in diploid grains if formed.

32. Sex Chromosomes of *Trichosanthes palmata*, Roxb.

K. RANGASWAMI, Annamalainagar.

The present work on the cytology of *Trichosanthes plamata*, Roxb. has been undertaken with a view to finding out if the dioecious habits of this plant is due to the presence of sex chromosomes.

T. palmata is a sturdy tendril climber with palmately lobed leaves, the upper surface of which is scabrid and is studded here and there with green dots. This is a dioecious plant growing commonly in and around this locality.

In the course of the present investigation, the meiotic and mitotic chromosome numbers of this plant have been determined for the first time. There are 22 and 44 respectively. The haploid chromosome number was determined by tracing the microsporogenesis in the male plant, while the somatic chromosome number was counted in the root tip cells of both the male and the female climbers.

Previous work on another dioecious species of this genus, namely, *T. dioica*, Roxb, has not revealed the existence of sex chromosomes in meiosis as well as in mitosis. But in this plant a heteromorphic chromosome pair has been observed at the metaphase and anaphase stages during meiosis. Difference has been noted between the somatic chromosomes of the male and the female plants. The sex chromosomes are of the XX (female) nad XY (male) type. The X chromosome is the largest and the Y the smallest. Thus the prevalence of dioecious habit in this plant is to be attributed to a difference in the nature of their chromosomes.

33. Cytological Study of the Indian Aristolochiaceae—I.

S. VENUGOPALAN, Annamalainagar.

Root-tips of *Aristolochia indica, A. bracteata* and *A. elegans* were studied; and the somatic chromosome numbers (2n) have been determined as under, for the first time: I. *Aristolochia indica*—12; 2. *A. bracteata*—12; 3. *A. elegans*—14.

Besides, the microsporogenesis of *A. indica* and *A. bracteata* have also been worked out and the meiotic chromosome numbers have been found as 6. This confirms the count of the somatic chromosome numbers.

Megaspore development has been traced and it is of the normal monosporic type.

Organogeny of floral parts seems to indicate that the flowers of *A. indica* and *A. bracteata* are protandrous contrary to the accepted belief that they are protogynous.

The work on *A. elegans* is continuing.

34. Cytological Studies in Combretaceae I.

V. R. RAJAGOPALAN, Annamalainagar.

Work on the cytology of *Combretaceae* was started just a year ago. The following genera are available for investigation in this locality: *Quisqualis, Terminalia, Calycopteris, Combretum* and *Lumnitzera*. The somatic chromosome number of the first mentioned plant namely, *Quisqualis indica*, Linn., has been determined for the first time from the root tip cells. This is found to be 22. Microsporogenesis is being traced to determine the meiotic chromosome numbers also. Work on the determination of the haploid and diploid chromosome numbers of the other genera is also in progress, with a view to finding out any correlation that may exist between cytology and taxonomy of this family.

Difficulty was experienced in the matter of fixation of the root tips and the flower buds because of the presence of a considerable amount of tannin in their cells. This, however, has been overcome to some extent by using a slightly modified Lewitsky's formula (1 part 10% formalin and 2 parts 1% chromic acid).

The present work is only the first of a series of papers on the cytology of *Combretaceae.*

35. Cytology of Apospory in *Doodia aspera.*

P. C. Sarbadhikari, Calcutta.

The paper deals with the aposporous development of the prothallia which usually occurs on the margin of the leaf. It is at first discernible as a small outgrowth caused by the division both of the marginal cells of the leaf and of those cells lying immediately within the margin. The marginal and apical prothallia are much more regularly heart-shaped, and in fact resemble ordinary prothallia of delicate structure. As the growth proceeds it is distinguished as a more or less continuous sheet of delicate tissue formed of somewhat rectangular cells.

The study of many pinnules show the apex either produced into a single prothallus or crowned by a number of prothalli with isolated groups. The principal cytological interest in the prothalli centres in the number of the chromosomes and in a comparison between the prothallus and the sporophyte in this respect. The embryo arises as a direct vegetative outgrowth from the prothallus, and, when very young, consists of a mass of cells in which the apical cells of the cotyledon, stem and root, are recognisable. There is no reduction of the chromosomes on passing from the sporophyte to the gametophyte.

36. Further investigation on the cytogenetics of *Scilla* species.

P. N. Bhaduri and A. K. Sarma, Calcutta.

A comparative study of the idiograms in the following six different species of *Scilla* has been made:—*S. verna; S. amethystina; S. autumnalis; S. bifolia; S. sp.* (unidentified) and *S. pratensis.* Besides other cytological data a careful measurement of the individual chromosomes, as well as the total length of chromosomes in the complement has been made to find out the lines of evolution in the genus. There are at least two distinct aneuploid series, one starting with *S. sibirica,* $n=6$ and the other from a still unknown species, but containing in the series the unidentified species of the present investigation ($n=7$) and *S. bifolia* ($n=9$).

An exact correlation between the maximum number of nucleoli and the total number of secondary constrictions of chromosomes has been established. It has been confirmed that the relative size difference between nucleoli is a constant and specific character. Species having heteromorphic pairs of nucleoli as found in the unidentified species of *Scilla* produce dissimilar gametes with respect to nucleoli and satellited chromosomes and hence should be considered as structural hybrids.

Definite evidence has been put forward in case of S. *amethystina* to show that the karyotype is altered in the same tissue due to fragmentation and translocation of chromosomes. The implication of such alteration of karyotypes in the production of new forms has been pointed out.

A study of the heterochromatic bodies present in the resting cells and the nucleolar constrictions of the metaphase chromosomes indicates that there are two kinds of heterochromatin which differ from each other in structure and function.

37. Karyotype analysis in some of the Indian strains of Barley.

P. N. Bhaduri and A. K. Sarma, Calcutta.

A critical re-investigation of the morphology of the chromosomes has been made in six strains of Indian Barley obtained from the Indian Agricultural Research Institute. Details which were missed by previous workers have been successfully brought out by using special fixatives like Platinic Chloride Formalin mixture and pre-treatments with various concentrations of Colchicine before fixation. Barley chromosomes are fairly long mostly with a median primary constriction. In three strains, 3 pairs of chromosomes have 10 secondary constrictions between them. One pair having a typical satellite another with a satellite at one end and an intercalary secondary constriction near the primary one and in the third pair each chromosome has three constrictions distributed in 4 pairs. In the other two strains 14 and 16 only secondary constrictions respectively are found. In the other strain pair of chromosome with intercalary constrictions being absent 8 constrictions are distributed in two pairs. All constrictions are nucleolar and it is suggested that the higher number of nucleoli and secondary constrictions in the cultivated varieties of Barley has been evolved through structural changes of chromosomes involving non-homologous translocation. This can be established by cytological examination of intervarietal crosses. Meiosis in all the strains examined is normal, showing 7 bivalents in the pollen mother cells though occasionally inversion bridges have been observed.

38. Cytogenetics of some common fruit trees I. *Eugenia* species.

P. N. Bhaduri and Ahmed Samsul Islam, Calcutta.

Cytological investigation of the following species of *Eugenia* has revealed that except *E. univora* they are all polyploid species: *E. uniflora* n=11, 2n=22; *E. jambos* n=23, 2n=;45; *E. jambolana* n=33, 2n=66; *E. jambolana* var, *caryophylifolia* n=22. The confusion in the determination of the chromosome numbers by previous workers has been explained to be due to the presence of multivalents and univalents along with bivalents during the metaphase I of the P.M.C. Due to non-disjunction and lagging of univalents the haploid number during second division was mostly found to be lower than the true haploid number. Hexa-, quadri-, bi- and univalents are present in *E. jambolana* which is an allo-hexaploid species. Pentavalents in addition to other univalents in *E. javanica* confirms its pentasomic nature (4+1). The basic number in the genus appears to be 11 which is found in *E. uniflora* and also in other genera of the Family. On this basis *E. jambolana* var. *caryophylifolia* is a tetraploid species from which by the union of an unreduced egg with a normal sperm the common *E. jambolana* has arisen. *E. jambos* (4n+2=46) is a hypertetraploid species with a pair of chromosome duplicated.

There is a correlation between pollen abortiveness and different sizes of pollen grains on the one hand and the irregular disjunction of the multivalents on the other.

Cytological evidence shows that *E. jambolana* var. *caryophylifolia* is a tetraploid species quite distinct from the allohexaploid *E. jambolana*. Whether the former is equivalent to *E. cumini* has to be ascertained by further cytological and taxonomical observations.

39. Cytogenetics of some fruit trees II. *Grewia asiatica* Linn. and *Nephalium longana* Camb.

P. N. Bhaduri and Sunanda Bose, Calcutta.

Cytological observations of *Grewia asiatica* Linn. (=*Grewia subenequalis*) and *Nephalium longana* Camb. have shown that the former has n=18, 2n=36 and the latter n=15, 2n=30 chromosomes. *N. longana* is a balanced diploid species showing normal

meiotic behaviour and high percentage of fertility. *G. asiatica*, on the other hand, is an amphidiploid species with the tetraploid chromosome number. Due to further structural changes of some of the chromosomes, most probably due to hybridization, the present *G. asiatica* (=*G. subaequalis*) has become a structural hybrid producing at least two quadrivalents and dissimilar gametes during meiosis. In view of the structural hybridity of the species it is expected that closely related but different forms of *Grewia asiatica* should be present in nature. This supports the observation made by Taxonomists that *G. asiatica* Linn. forms a heterogeneous assemblage. The frequency of quarid-, tri-, bi- and univalents during meiosis has been presented in a tabular form. The implication consequent to disjunctional or non-disjunctional orientation of ring quadrivalents during metaphase I in their relation to duplication or deficiency of genes in the gametes have been discussed.

A correlation between the multivalent and univalent formation to percentages of abortive and different sizes of pollen grains has been worked out. The present observation supports the view that in a polyploid species duplication or deficiency of one or more chromosomes though affect the size of the pollen grains, may not on the other hand affect the viability which is dependent not on number alone but on the chromosome balance.

40. Preliminary investigation on the cytogenetics of *Trewia nudiflora* Linn., *Chrozophora plicata* Neck., *Flacourtia Ramontchi* L'Herit., & *F. sepia Roxb.*

P. N. Bhaduri and A. K. Kar, Calcutta.

The chromosome numbers in the following species have been determined for the first time: *Trewia nudiflora* Linn. (Fam. Euphorbiaceae) n=11, *Chrozophora plicata* Neck. (Fam. Euphorbiaceae) n=11, *Flacourtia Ramontchi* L'Herit. (Fam. Flacourtiaceae) 2n=22 and *F. sepiaria* Roxb. n=11.

In the somatic complement of *Flacourtia Ramontchi* there are six chromosomes with secondary constrictions, two of which are extra long in size. A very small satellited chromosome without a homologue has been observed. Definite evidence of the presence of sex-chromosome in any of the species has not been found. The meiotic behaviour of the chromosomes in all the species is normal except in *Trewia nudiflora*, where a high percentage of inversion bridges has been observed. Clear evidence of secondary association between bivalents during first metaphase indicates that the species are probably secondarily balanced polyploids.

An embryological study of *Flacourtia sepiaria* shows a Normal-Type of development of the female gametophyte with a typical octo-nucleate embryo-sac. Exceptional cases showing the development of more than one megaspore has been recorded. The embryological characters of *Flacourtia sepiaria* are in conformity with the characters of the Order Parietales.

41. A preliminary investigation on the karyotype analysis of wild and cultivated Tuberiferous Solanums.

Jyotirmay Mitra, Calcutta.

Although much cytological work has been done in wild and cultivated potatoes, it is still not yet proved whether *Solanum tuberosum* is an auto or allo-tetraploid species. Gates has pointed out that a new line of evidence in this direction could be obtained from the study of karyotypes and nucleolar relations. Critical karyotpe analysis in a few diploid and tetraploid species has only been done by Sepeleva using Platinic Chloride as a fixative. Other workers in this direction are not so critical.

Material of wild and cultivated potatoes fixed in Platinic chloride mixture which was collected at Cambridge during 1938 has been analysed. Analysis of the somatic chromosomes of two diploid (wild), two triploid (wild) and four tetraploid (both wild and cultivated) species and varieties has been made. In the two diploid species *viz., S. pseudomaglia* and *S. Kesselbrenneri* preliminary observations have shown that there are 8 and 10 to 12 secondary constricted chromosomes in the two species respectively; and in the two triploid species *viz., S. Rybinii* and *S. Commersonii* there are 18 secondary constricted chromosomes. In a tetraploid variety (Sharpes Express) as many as 26 secondary constricted chromosomes could be detected. In "King Edward" there are two and in "Champion" four fragments are present in the chromosome complement. For the first time a triploid form of *S. Rybinii* has been found. The nature of polyploidy and the probable cytological basis of origin of different cultivated varieties have been discussed.

42. *Cytogenetical studies in Musaceae. I. Karyotype analysis of *Musa* and fragmentation of chromosomes as an evolutionary process in the genus.

A. K. Chakravorti, Calcutta.

The subgenera of *Musa* have different chromosome numbers; *Physocaulis* having 2n=18, *Eumusa* 2n=22 (wild and diploids) or 3n=33 (cultivated and parthenocarpic triploids) and *Rhodochlamys* has 2n=20 (*M. coccinea, M. borneensis* etc., determined by Cheesman & Larter) or 2n=22 (*M. rubra, M. ornata* etc.).

Karyotype analysis of different species shows 17 morphologically distinguishable types of chromosomes. Individual species have distinctive karyotypes composed of 2 to 6 of the above 17 types of chromosomes.

The maximum number of nucleoli in *Physocaulis* and *Eumusa* are exceptionally high (26 to 34) corresponding to similarly high number of nucleolar constrictions of the chromosomes. Neither polyploidy nor previous non-homologous interchange between nucleolar and non-nucleolar chromosomes, nor fragmentation of chromosomes across their secondary constrictions can explain the high number of nucleoli observed. It has therefore been deduced that a genome may possess more than one and even many nucleoli instead of only one as originally visualised by De Mol.

Evidence has been put forward to show that the diploid species of *Eumusa* having 2n=22 chromosomes have originated from the 18-chromosomed species like *M. superba*, through fragmentation of its two particular pairs of chromosomes across the secondary constriction regions.

43. *Cytogenetical studies in Musaceae. II. Meiosis in some diploid species of *Musa* with special reference to secondary association of bivalents.

A. K. Chakravorti, Calcutta.

Meiosis studied in 8 different diploid species of the subgenera *Physocaulis* and *Eumusa* is normal and regular excepting *Ram kela* (a native name of the species which grows wild in the Chittagong Hill Tracts, E. Pakistan, and appears to be a new one) belonging to *Eumusa*. On the grounds of meiotic irregularities, this species has been interpreted to be a structural hybrid produced in consequence of segmental interchange between non-homologous chromosomes.

A correlation between the size and sterility of the pollen grains to meiotic irregu-

*These investigations were carried out with the aid of a grant from the Indian Council of Agricultural Research.

While the most frequent association between bivalents varies from species to species, the maximum association on the other hand, is the same in all the species of a subgenus. Thus the two species of *Physocaulis*, *M. superba* and *M. Agharkarii* have both 1 (3)+3 (2) bivalents as their maximum association, while all the 6 species of *Eumusa* examined show a maximum association of 1(4) + 1(3) + 2(2) bivalents. The nature of maximum association indicates that 4 should be the basic chromosome number for the genus and not 8 as previously suggested by Cheesman.

The morphology of the chromosomes and the type of maximum association of bivalents in the two species of *Physocaulis*, indicate that they are amphidiploids originated from a basic set of 4 chromosomes.

44. * Cytogenetical studies in Musaceae. III. Cytological considerations for the delimitation of the subgenus *Rhodochlamys* of the genus *Musa*.

A. K. CHAKRAVORTI, Calcutta.

Cytological studies have been made in 5 species of *Rhodochlamys*. This subgenus constitutes a cytological group quite distinct from *Eumusa*. The two subgenera cannot however, be distinguished from each other on morphological characters alone, except that *Rhodochlamys* has fewer flowers (1 to 6) in one row per bract as compared to many in two rows in *Eumusa*. Nor are they separable on the basis of seed-shape and chromosome-number as claimed by Cheesman and Larter.

It has been found that only in the details of the morphology of the chromosomes, the size relation and maximum number of nucleoli, and the nature of the maximum association between bivalents, the two subgenera are distinguishable from one another. Thus *Rhodochlamys* has fewer morphological types of chromosomes, which are again, quite distinct and appear to be phylogenetically different from those found in *Eumusa*. The members of *Rhodochlamys* have much smaller number of nucleoli (10-14) of distinct and fewer size classes in contrast to those of *Eumusa*, which have unusally high number of nucleoli (26-34) of various sizes. Again the nucleolar constrictions of *Rhodochlamys* are all of the nature of satellites, whereas in *Eumusa* they may be satellites, secondary constrictions and SAT-threads alone without the SAT-heads. Further, the supernumerary constrictions, the presence of which is a remarkable feature in some of the chromosomes of *Eumusa*, are exclusively lacking in *Rhodochlamys*. Lastly, the maximum association between bivalents in *Rhodochlamys* is 3 (3) + 1 (2) as against 1 (4) + 1 (3) + 2 (2) of *Eumusa*.

The cytological facts put forth above do not indicate any close relationship of *Rhodochlamys* to either *Physocaulis* or *Eumusa*.

45. *Cytogenetical studies in Musaceae. IV. Karyotype analysis of the parthenocarpic bananas and the cytological basis of their variation.

A. K. CHAKRAVORTI, Calcutta.

The parthenocarpic bananas are all alloetriploids with $3n=33$ chromosomes. A remarkable feature of the karyotypes of the different varieties is that they are variable within a given variety and even within the same individual. Such variations are noticeable with respect to the number of chromosome types, number of a particular type of chromosome, sum total of lengths of all the members of a chromosome complement, length of an individual member, total number of nucleolar constrictions etc.

Such occasional and spontaneous changes in the morphology of the chromosomes have been explained on the basis. of rearrangement of chromosome segments following translocation, deletion and inversion in the somatic nuclei.

* These investigations were carried out with the aid of a grant from the I.C.A.R.

Like the variability of the karyotypes, the degree of pairing between the chromosomes is also variable in different varieties.

The origin of numerous parthenocarpic varieties of banana under cultivation which have no scope of producing new types by hybridization and which are accustomed to clonal propagation alone, is due to the above process of chromosome rearrangements operating in the somatic meristem. A vegetative bud developed from such a mutated tissue will represent a well-defined genotype which is also likely to differ phenotypically from the parent.

46. *Cytogenetical studies in Musaceae. V. Idiogram studies with special reference to Chromosome-Nucleolus relationship and its bearing on the cytogenetics of *Heliconia*.

A. K. Chakravorti, Calcutta.

The genus *Heliconia* has two lines of chromosome number, 2n=22 and 2n=24. The 24-chromosomed species, like *H. brasiliensis*, have evolved from the 22-chromosomed ones, like *H. metallica*, by fragmentation of a particular pair of chromosomes across the secondary constrictions.

The different species have a fairly large number of nucleoli and correspondingly a specific character. *H. psittacorum* and an undetermined species are structural produced after fragmentation of a chromosome across the secondary constriction are capable of organising a nucleolus due to the presence of a piece of constriction-thread at one end. It is suggested that fragmentation across nucleolar constriction may not only alter the karyotype but may also bring about a proportionate increase in the maximum number of nucleoli depending on the locus of the break.

The relative size difference between nucleoli of a species has been found to be a specific character. *H. psittacorum* and an undetermined species are structural hybrids with reference to heteromorphism in the nucleolar size. This is correlated to heteromorphism in a pair of nucleolar chromosomes and the formation of a quadrivalent ring in the P.M.Cs.

A study of the idiograms of the different species suggests that structural changes of chromosomes and not polyploidy have played an important role in the differentiation of the species of *Heliconia*.

Cytological findings support the separation of the genus *Heliconia* as a distinct tribe *Heliconieae* from the *Strelitzieae*.

47. On the cytogenetics of cultivated Jasmines.

Sm. Mridula Dutt, Calcutta.

Mitotic and Meiotic studies of six ornamental speceies of *Jasminum* are being carried out.

The diploid number 2n=26 occurs in four species while one shows the triploid number (3n=39) and another the tetraploid (4n=52). Meiotic irregularities include formation of multivalents in the polyploid forms with trivalent and quadrivalent chains predominating, and with a corresponding percentage of univalents. Secondary association is seen in one species, which also casts out several (3-5) small chromatic bodies in the cytoplasm during meiotic anaphase.

There is an abundance of aborted pollen which is correlated to the meagre formation of fruits and complete sterility of seeds. Germ pores vary in number from one to four, the greatest incidence of the highest number being found in the tetraploid.

* This investigation was carried out with the aid of a grant from the I.C.A.R.

PHYSIOLOGY AND ECOLOGY

48. The Structural Basis of Sensitivity in *Mimosa Pudica* Linn.

Sm. Mridula Dutt, Calcutta.

Reaction to stimuli consists in the bending up and down of all pulvini of the bipinnate leaf. This is facilitated firstly by the centralization of the xylem vessels which are only spirally thickened, and secondly in the cortex being aerenchymatous. Air spaces render it possible for the spongy tissue with isodiametric elements to undergo compression or expansion with ease. Absence of stomata on motor parts and the presence of compact tissue on either side of the spongy pulvinus help in its contractility. Response results from the differential elasticity of adaxial and abaxial halves of the cortex, one of which is thicker walled than the other. The difference in speed of conduction in stem and leaf may be correlated to only one structural difference, namely the presence of two longitudinal air passages along the petiole, which may help in the conduction of stimuli to interior tissues.

Contractile cells contain specialized deeply staining cell contents, which occur to a lesser extent in other parts. Phloem occurs in 2 strands inside and outside the xylem, and occupies the centre of pulvini, where pith is absent. Specialized hairs occur everywhere and the only outgrowths occurring on motor organs, in contrast to the prickles and hairs on other parts.

49. Growth response of Jute plants to Yeast extract and Vitamin Bi.

J. C. Sen Gupta, Calcutta.

Two species of Jute-*C. capsularis* and *C. olitorius* were grown in (*a*) Sand culture with mineral solution, and in (*b*) Soil, and the different treatments were the addition to each pot of (i) 0.5 mg. Yeast extract, (ii) 0.05 mg. Vitamin Bi. There were 5 pots, each with 4 plants *i.e.*, 20 plants per treatment. As the plants grew, the course of growth was followed by fortnightly readings of total height, number of internodes, number of mature leaves, and number of leaves shed. In addition the data of initiation of the first flower bud, and the first visible fruit were also noted separately for each plant and the data recorded as mean of 20 plants in each case.

The nature of response though not very well marked may be briefly stated as follows:—In (1) *C. capsularis*—the addition of Yeast extract and Vitamin Bi showed an acceleration of growth in Sand culture, but a retardation in plants grown in Soil; (2) *C. olitorius*—the addition of Yeast extract and Vitamin Bi produced a retardation of growth in Sand culture, but an acceleration in Soil.

The time of flowering and fruiting seemed to remain uninfluenced in the different treatments.

50. Preliminary Investigations on Growth of *Cephaelis ipecacuanha* under tropical conditions of Calcutta.

G. C. Mitra and D. Chakravarty, Calcutta.

The experiments were carried out on prepared soil beds and under thatched shade as is being done in the nurseries of Mungpoo. The seeds of *Cephaelis ipecacuanha* (Kew variety) sprouted in April after 4 and 5 months of their sowings but they died soon, and the young plants received from Mungpoo in February, 1947 and the cuttings made from a few of them especially the root cuttings showed the best activity in August when the rainfall was 15.4 inches and the mean minimum temperature was 79.5°F, whilst in November when the rainfall was nil and the mean minimum tem-

perature was 64.6°F they showed definite signs of drying up. As the plants are thriving well at Labdah the source of plant materials, the fall in monthly mean minimum temperature in November may not adversely affect the growth of the plants in the plains. But the difference in atmospheric humidity between August and November might have an influence and the plants were subjected to increased humid condition in November in order to investigate the question. It was found that on increasing the humidity the growths of young plants and cuttings were revived to a great extent as observed by the development of branches and leaves. Thus in November onwards through the winter months the conditions of growth of the cuttings and the young plants, when kept under humid condition, was much better than what was found in August under nursery condition.

The observations indicate the favourable influence of lower temperature of winter months as compared with August provided the humidity is not allowed to decrease. And the mean maximum temperature of the plain appears to be above the optimum temperature for growth of the plants otherwise we would have expected the best growth during the rainy season—rather than in winter months under artificially increased humid condition.

51. Effects of temperature and short day length on acceleration of flowering in winter rice.

S. M. Sarkar and B. N. Ghosh, Calcutta.

Effects of high and low temperatures and in combination with short day length have been studied on two winter varieties of rice, *Bhasamanik* and *Rupsail* in pot culture experiments. The effect of short day treatment of 8 hours for 4 and 6 weeks has also been studied in randomised field plots with one variety, *Rupsail.*

Seeds of *Bhasamanik* and *Rupsail* were soaked in water at the rate of 28 to 30 per cent per fresh weight for 48 hours in order to sprout the embryos. Then the sprouted unsplit seeds were transferred to the incubator regulated at 35°C for 10 and 20 days; for low temperature treatment the sprouted unsplit seeds were kept in the refrigerator controlled at 10°C for 5 days. After high and low temperature treatments the seedlings were grown in seedbed pans with a control set for each variety. One week after, short day treatment of 8 hours was begun. Then the seedlings were transplanted in earthenware pots with 10 replicates for each treatment; altogether there were 400 pots for these two varieties.

Short day followed by low temperature accelerates flowering in the main stem as well in the subsequent tillers of *Rupsail,* while short day treatment alone induces early flowering in the main stem. High and low temperature treatments do not show any acceleration of flowering in these two varieties of rice. Flowering is retarded by high temperature in combination with short day treatment, except in the main stem of *Rupsail* where an earliness is induced with short days followed by high temperature for 10 days only. In the field experiment short day treatment of 8 hours for 4 and 6 weeks shows a marked earliness in ear emergence in *Rupsail.*

52. Effect of age on the regeneration of *Bryophyllum* leaves.

S. Pattanaik, Balasore.

In the present investigation, the effect of age on the regeneration of *Bryophyllum* leaves has been studied on a quantitative basis. The data obtained in this study point out that the power of regeneration increases with age. Well grown-up isolated leaves proliferate much earlier in comparison to young ones.

Mineral solution has little effect on the regenerating leaves of *Bryophyllum*, though young leaves show a slight increase in the presence of mineral solution.

53. Effect of Hydrogen Ion concentration and salt content of the medium on the development of sett roots in Sugarcane.

R. NARASIMHAN and N. L. DUTT, Coimbatore.

Unfavourable reaction and salt accumulation are two of the common defects met with in soils which affect the growth of roots and consequently the development of the plant.

A knowledge of root development under such conditions is useful to the Plant Breeder for evolving tolerant strains.

Preliminary studies have been made at the Coimbatore Sugarcane Breeding Station to observe the effect of reaction and salt concentration of the medium on sett root development of certain varieties of Sugarcane.

1. Effect of reaction of nutrient solution ranging from *p*H2 to *p*H11 on sett root development was studied on two varieties of Sugarcane Poovan and Co. 432. The results indicated that optimum pH for vigorous root growth is 50 while there is another optimum at *p*H 9.0 where both the varieties *i.e.*, Co. 432 and Poovan showed good root growth. Co. 432 was found to be more tolerant to variation in *p*H both in the acid and alkaline side than Poovan.

2. The effect of salt concentration on sett root development was studied with three varieties, Red Mauritius, Co. 432 and Co. 419. It was found that 0.20 per cent and 0.10 per cent of salt concentration (NaCl) adversely affected the root development in all the three varieties, Red Mauritius being affected most. With 0.05 per cent salt concentration Co. 419 showed vigorous root growth while in the case of Red Mauritius there was a set back in root growth as compared to the control.

54. Effect of some carcinogenic Hydrocarbons on the mango fruit.

S. C. AGARWAL and G. S. VERMA, Lucknow.

The effect of four hydrocarbons *viz.* 1,2,5,6. Dibenzanthracene, 9,10 Dimethyl 1,2 Benzanthracene, 1,2 Benzathracene, and Methylcholanthrene in different concentrations was stdudied on two varieties of mango (*dasehri* & *safeda*) by external application on the skin after rubbing with sand paper and by direct injection at the tip of the fruits at various stages of the growth.

Methylcholanthrene was found to be most reactive. 1,2,5,6 Benzathracene also produced some effect while the others showed no visible effect. Direct injection alone, was found to be effective.

Dark brown lesions were produced around the point of injections which showed necrosis of tissues in some fruits, while some escaped with yellowing of the skin alone. Higher concentrations (1%, .01%) were more reactive than lower concentrations. Young fruits have been found to be more susceptible than fully mature ones.

55. Observation on the Sand Vegetation of some parts of Bengal, Orissa and Madras.

K. BISWAS and S. K. CHOUDHURI, Sibpur.

A preliminary study of some of the characteristic sand flora along the sandy shores of Coxbazar (Chittagong), Chilka Lake, and Gangam district in Madras Presidency is reported here.

The species found are only a little over three decades. The phanerogams often form small patches or what may be called ecads or society of their own spreading over the flat or undulating sand dunes. Sometimes *Tephrosia purpurea* grows as a dense impenetrable bush on the top of the sand hills. Notes on systematics, ecology and other botanical aspects of these plants have been incorporated in the paper.

56. Studies on the Plankton flora of River Hooghly with special reference to the working of the filter beds of Calcutta Water Supply.

HIMANSU KUMAR ROY, Calcutta.

Every year during the summer and winter months there is a choking of filter beds due to algal growth which results in a reduced filter water supply of Calcutta. A study was made during last three years to see if the Plankton organisms in the river water have got any direct influence on the working of the filter beds. It has been found that the diatoms play the most important part in the execution of the cycle of seasonal and annual variations of the Phyto as well as total plankton. The maximum yield of the diatoms is recorded during the winter months. The same genus of diatom has not got similar yields during the different years of study. Thus *Melosira* was found to be the most dominant diatom during the years 1945-46 (July-June) and 1946-1947. In the third year, however, *Coscinodiscus* took up the dominant phase. This change of annual dominancy seems to be due to the natural cycle of annual variation which can only be ascertained by collecting for some future years. The protozoa (including all the flagellates and ciliates) comes second to the diatoms regarding its annual dominancy.

The total annual rainfall is seen to have a distinct reverse relation with the yield of plankton. There is a regular increase every year in the average annual yield of the diatoms expressed as percentage of the phytoplankton yield. Thus the phytoplankton is more and more represented by the diatoms (sea-water organisms) as the successive years pass on, the Hooghly water thus approaching the characters of sea water. This is also supported by the regular increase of the yearly average of the salinity of the river water. The river water has got the highest dissolved oxygen content during the winter, the period of maximum phyto-plankton yield. This seems to be due to increased photosynthesis. The optimum temperature for the growth of diatoms is found to be near about 20° C.

The growth of diatoms mainly of the Centricae group in the river water seem to be directly responsible, with or without some other organisms of the Schizophyta, for the chokage of the filter beds during the winter. This is also supported by the findings of the direct microscopic observation of the sand from a choked filter bed. But the chokage during the summer when the growth in river water is almost negligible, seems to be due to growths of diatoms such as *Synedra* etc., with or without some other organisms, intrinsic to the settling tank and filter beds. This will be discussed elsewhere.

57. A comparative study of meadows.

R. MISRA, Saugor.

The study comprises floristic and environmental details of five meadows with a similar appearance, at Saugor.

The area of the quadrat used for sampling was determined by the species-area curve method. It was to be 0.16 sq. meter. Ten samples of this size were taken at random in each meadow for the determination of frequency, density and cover of the species. These are correlated with physiographic, biotic and edaphic factors obtaining in the meadows.

Out of a total of 53 species, only one was found to be common to all the meadows and 9 were found in four of them. Lists of species with preferences for soil types regarding depth, leaching and erosion, grazing, etc., are drawn from the study with relevant discussion.

58. A preliminary survey of the vegetation of Saugor Lake.

R. Misra and J. P. Shrivastava, Saugor.

The physical features and the macrophytic vegetation of a large lake at Saugor, C.P., are described in this paper. The vegetation is grouped into four associes, *viz.;* (i) the deep water submerged associes, (ii) the shallow water submerged associes, (iii) the floating leaf-form associes and (iv) the amphibious marsh associes. The species belonging to each of these are listed with their frequency-abundance, and factors affecting their growth are discussed.

59. The vegetation of Saugor University plateau.

R. Misra and S. C. Pandya, Saugor.

The characteristics of the plant communities showing strong seasonal phases as are found on terraces and slopes, along buildings and gullies and drains, of the plateau are given in the paper. An analysis of the habitat factors reveals striking correlations between the incidence of species and edaphic factors. The results of the study are illustrated with maps and charts.

60. Notes on the Autecology of *Anisochilus eriocephalus* Benth.

R. Misra and Trilochan Singh, Saugor.

Anisochilus eriocephalus Benth. (Family-Labiatae) grows gregariously on tiled roofs in Saugor and neighbouring villages. The plant is an annual appearing in the rainy season and completes the life cycle before the end of October. The seed output is large but the percentage germination does not exceed 12 and seedling mortality is very high. The factors affecting each of these stages in nature have been studied in the field and by means of culture experiments in the laboratory. It is found that the plant is susceptible to waterlogging and interspecific competition on account of which it is driven to sloping roof of houses.

61. Ecological problems of the humus layer in English forests.

G. S. Puri, Dehra Dun.

On the basis of characteristic ground flora communities and associated tree seedlings, humus layer in some broadleaved forests in the south of England (Whippendell woods, Box Hill, Tring and Moor Park) was classified into three main types. These classes correspond broadly to P. Mullers' well recognised biological types-Mull and Mor-with types intermediate between the two extremes.

The ground flora communites and seedling growth was found to be intimately related to the whole complex of soil conditions rather than to any single factor. This confirms Pearsall's conclusions about the North England forests, and also indicates their applicability equally to the forest of South England.

The different types of soil recognised in these woods were found to be related to topography, tree vegetation and worms. Broadly speaking, soils at lower levels were mull with large worms, while mor or transition-to-mor soils were usually observed at

upper levels. Worms were either absent or were very few in numbers in the latter type of soils.

Tree vegetation was found to have a far greater influence on the development of the humus layer. By virtue of their capacity to absorb minerals from deeper layers and bringing them to surface of the soil, trees on the whole tend to keep minerals in circulation and militate against the loss of leaching. Thus, the chemical composition of litter, which determines its palatability to worms and rate of decomposition in Nature, assumes great importance in determining the soil types. Tree litter with a high C : N and a high C : lime is not only less readily eaten by worms but its decomposition under natural conditions is slow. Litter of low C : N and a low C : lime on the other hand, decomposes faster and is palatable to worms. The rapid decomposition of litter releases plant foods as nitrates, and minerals which not only act against soil acidity but maintain a high base status of the soil and produces fertility conditions in forest. The accumulation of litter on the other hand, accentuates leaching; does not liberate plant foods and so makes the soil infertile. Thus, trees with high lime requirements and low C : N tend to increase soil fertility forming mull soils of high reproductive capacity; while those with low lime requirements and a high C : N generally result in unproductive conditions and mor soils.

The regeneration of forest trees is intimately related to soil types and soil fertility. Thus, a greater number of English forest trees *e.g.*, ash, cherry, hazel, oak and even beech grow as seedlings on mull soils. The only species regenerating on mor soils are pine, birch and mountain ash. The soil fertility is, thus, of utmost importance in regeneration and successful establishment of a forest. In the damp climate of Britain the general trend of soil development is one of decreasing soil fertility with advancing age. The importance of species like ash, hazel and cherry which maintain soil fertility and condition forest regeneration can not be over emphasised for successful silviculture in that country. The danger of planting conifers is obvious.

62. Surface Geology, vegetation and plant succession in the London Basin,

G. S. Puri, Dehra Dun.

This stduy was conducted on the soils and vegetation of the London basin, which is a syncline bounded on the North by Chilterns Hills and on the South by the North Downs. The dominant rock in this region is the Chalk, masked by clay-with-flints and deposits of later geological ages. These deposits consist of clays, sands, loams, gravels and alluvials which were derived mainly from rocks not particularly rich in lime. They are variously exposed and in the centre of the syncline make up all or the major part of the surface soils, the strata of the Chalk seldom affecting the vegetation.

Five examples were studied, two (Box Hill; and Tring) on the scarp slopes and three (Epping Forest; Whippendell woods and Oxshott) on the dip slope of the Chalk.

On the slope of the chalk escarpment the soil is usually immature and rich in lime. On account of the characteristic topography and composition of the rock it is obvious that a high base status of the soil would be maintained along this slope. On the dip slope, however, the surface soils being made up of leached residues of chalk or deposits of reassorted material, are lime deficient. These soils must have been rich in bases when immature but they have now attained stability and are leached of minerals.

The soils on the two slopes of the chalk are thus, fundamentally different and would be expected to bear distinctive vegetation types.

The vegetation on the *two slopes* was found to be distinct and the following account shows a clear relation of the vegetation with the geological features.

(1) Ash and beech communities as a rule are confined to *scarp slope,* while Oak is the chief type on the *dip slope.*

(2) On immature soils of the scarp slope ash forms a seral community usually on lower levels. Its presence in valleys or elsewhere on the dip slope is associated with similar types of soil provided locally by patches of Glacial Gravel, Silty loam or an outcrop of the chalk. On account of the low lime content of the soil and intensity of leaching the ash community here seldom remains in a seral stage and either develops into an edaphic association of ash-oak-beech or is succeeded by an oak wood.

(3) Similarly, beech normally forms a seral community on the scarp slope at situations on valleysides on the dip slope. In local patches of Sand or Pebble Gravel or in disturbed Oak woods on the dip slope beech forms an oak-beech community. Again, depending upon the lime content of the soil and intensity of leaching the oak-beech either reproduces itself as an edaphic association or is succeeded by beech probably finally degenerating into a heath.

(4) On the *dip slope* of the Chalk, Oak is a leached edaphic climax reproducing itself naturally. On sands or in areas from where oak woods have been clear-felled vegetation burnt, birch community originates. It is, however, succeeded by Oak and or Oak → Beech heath.

The forest vegetation in the London Basin can be viewed as a series of successions in the general sequence:-

Mixed deciduous colonising woodland → oak wood → Heath, in which the early seral stages are preserved by (i) geological features (nature of rock and the amount of Calcium (ii) by immature topography-scarp slopes *versus* dip slopes (iii) by location of accumulation areas and (iv) by biotic influences.

ECONOMIC BOTANY

63. Common paper yielding plants of India.

K. Biswas and Bazli Ali, Sibpur.

Scarcity of paper since the war and even the present post-war period prompted the authors to investigate into the raw materials available in India. A systematic list of the common paper yielding plants has been drawn up and the range of distribution of each of the species worked out. Field experiments are being carried on with a view to improve the most important crop of the paper yielding plant materials namely *Dendrocalamus stictus.* Notes on the possibilities of large scale cultivation of other more important paper plants for the manufacture of hand-made paper as a home industry have also been incorporated in the paper.

64. *Cephaelis ipecacuanha* (Brot) A. Rich.—The emetine yielding plant, its Botany and scope for cultivation in India.

K. Biswas and M. A. Sampath Kumaran, Sibpur.

The well-known medicinal plant-Ipecacuanha, a native of Brazil is accepted and used as a specific against dysentery for the last 200 years. There exists therefore, considerable literature on the Botany and the experimental cultivation of this emetine yielding plant. In India experimental cultivation and botanical investigation were undertaken as early a period as 1886 by Sir George King, the then Superintendent, Royal Botanic Garden, Calcutta and was subsequently pursued by his successors. The results obtained so far from the study and trial cultivation of this delicate plant led to the introduction and successful cultivation of the authentic species in the lower

hill forests of Sikkim-Darjeeling Himalaya and the Nilghiris. The authors in this paper have discussed the possibilities of cultivating this plant on an extensive scale in suitable areas in India with a view to meeting the great demand for this plant and have also dealt with its ecology, morphology and systematics against the background of the past researches.

PALEOBOTANY

65. *Dadoxylon eocenum* sp. nov. from the Chhindwara District (C.P.).

Mrs. S. D. Chitaley, Nagpur.

The specimen described in the present paper is a piece of Coniferous wood, mostly secondary, collected from the Chhindwara District (C.P.).

It is characterised by distinct, narrow growth rings, resiniferous tracheids; radial pits bordered, 1-3 seriate, sometimes in groups of 2-5, contiguous hexagonal, sometimes opposite; tangential pits present, bordered, scattered, sometimes 1-2 seriate, alternate; medullary rays 1-2 seriate, 1-15 cells high, average height 4 cells; pits in the field 1-7, bordered or simple.

On the basis of the anatomical details, the specimen has been referred to the genus *Dadoxylon*. Comparisons have been made with all the known species of Southern *Dadoxyla* and also with *D.* (*Mesopitys*) *Tchihatcheffi*, the solitary species from the Northern hemisphere, and it is concluded that this specimen differs from all the others in one respect or the other. It shows maximum resemblance with the following five species, but again differs from them in the characters given against each of them respectively:—

D. bengalense, Holden: differs in the nature and height of the medullary rays, and in the no. of field pits.

D. sp. b. Sahni: differs in the nature of the medullary rays and in the absence of uniseriate radial pitting.

D. Arberi Walton: differs in the height of the medullary ray, the no. of the field pits and in the absence of the tangential pits.

D. resinosum Shukla: differs in the seriation of the radial pits (being 1-4), height of the medullary ray, and the no. of the field pits.

D. Chandaensis, Chitaley: differs in the height of the medullary ray, and the no. of field pits, and in the presence of fungus like inclusions.

Since the species is different from any other type hitherto known, it is proposed to name it as *D. eocenum*, the specific name referring to the Eocene beds of C.P., from where it has been discovered.

66. Microfossils of Laitryngew Coal Seam and the Age of the Cherra Sandstones.

J. Sen, Calcutta.

An attempt has been made to approach the problem of the age of the Cherra Sandstones by micro-botanical examination of a few coal samples from the associated Laitryngew seam, as an independent line of enquiry. Abundance of angiospermic remains represented by the pollens of *Magnolia*, oak, date palm, some wood fragments etc., and scanty occurrence of gymnospermic elements indicate a Tertiary age for the Cherra. But more extensive work is necessary to substantiate this conclusion. The

pteridophytic fragments are very few. The presence of Magnolian, oak, and coniferous (?) pollens further suggest that the flora is of temperate nature, and that of palm shows a relationship between the formation of the beds and arid condition. This fact has been substantiated from other geological evidences.

About 23 species of pollens and spores, and several wood fragments and cuticular structures have been described and their affiinities discussed. Some of these findings provide a valuable ground for research regarding the suggested origin of scalariform from pittings and reticulation.

PHARMACOGNOSTIC BOTANY

67. Pharmacognostic studies on commercial varieties of *Rauwolfia serpen-*

S. C. Datta, Calcutta.

The paper deals with the morphological and histological characters of the roots of different samples of *R. serpentina* roots collected from different parts of India as well as the roots of *R. canescens* Linn. which often grow side by side with *R. serpentina* and is used as a common adulterant. There is a good demand for genuine *Rauwolfia serpentina* roots due to its action as a sedative drug. It lowers blood pressure and stimulates uterine movements as well as the plain muscles of the gastrointestinal tract. For distinguishing between the roots of the different samples, the following factors were taken into account, *viz.*, macroscopic and microscopic characters including quantitative microscopic measurements of cells and tissues, measurements of starch grain diameters, their mean and range, determination of starch grain index, determination of number of cork cells per square millimetre, and measurements of lengths of xylem vessels. It was found that *R. serpentina* and *R. canescens* roots could be easily distinguished by taking into account starch grain index or number of cork cells per sq. mm. or xylem element length or histological details. The distinction between the different collections of *R. serpentina* roots was, however, more difficult and it could only be accomplished by a careful consideration of starch grain index. *i.e.*, the percentage of starch grains having diameters greater than a certain limit. It was also found that this factor is dependent on the diameters of the roots and consequently on the age of the specimens. Five varieties of *R. serpentina* roots, *viz.*, Bengal, Bihar, Dehra Dun, Assam and Ceylon were taken into account. The different samples vary in their constituents and the Bihar sample is reported to be rich in Serpentine group whereas the Dehra Dun variety is rich in Ajmaline group.

68. Kurchi Bark and its adulterant.

D. Datta and Amiya Datta, Calcutta.

This paper deals with the comparative pharmacognostic studies of the barks of *Holarrhena antidysenterica* Wall and *Wrightia tinctoria* R. Br., a common adulterant of *Kurchi*. Comparative macroscopic and miscroscopic examinations of the two barks have been studied. The main points of differences are the absence of fibres and presence of less thickened wall and bigger lumened stone cells in *Kurchi* (*Holarrhena antidysenterica* Wall). The fibres of *W. tinctoria* have cellulose walls.

SECTION OF ZOOLOGY AND ENTOMOLOGY

PRESIDENT: DR. M. L. ROONWAL, M.Sc., Ph.D., (Cantab), F.N.I.

1. Further report on the survey of the marine fauna of Karwar.

A. M. PATIL and P. W. GIDEON, Dharwar.

The paper is a more detailed study based on further collections made at different seasons of the year.

2. Nucleic acid sycle and the time of division of the heterochromatic sex-chromosome of the grasshopper, *Attractomorpha* sp. (Acrididae).

S. P. RAY CHAUDHURI and IRA BOSE, Calcutta.

The nucleic acid cycle of the sex-chrmosomes of *Attractomorpha* sp. (male) throughout the different stages of spermatogenesis has been studied. The sex chromosome being heterochromatic is over-charge with nucleic acid at the resting stage of the early spermatogonial cells and progressively becomes denucleinated. It, therefore, reaches the metaphase stage undercondensed. The ever-consideration of the heterochromatin at the resting stage is due to the process of nucleic acid attachment starting at the previous divisional cycle at a stage when there was an abundance of supply of nucleic acid in the cell due to the denucleination of the euchromatic autosomes. The differential behaviour of heterochromatin and euchromatin is no longer present in the late spematogonial divisional stages but becomes apparent again in meiosis. The nucleic acid cycle also determines the time of division of the sex chromosome in meiosis. It divides at the resting stage just preceding meiosis when its nucleic acid charge is minimum.

3. Multiple sex-chromosomes and their determinate disjunction in the grylid, *Euscyrtus* sp.

S. P. RAY CHAUDHURI and G. K. MANNA, Calcutta.

X_1X_2Y mechanism of sex determination in the *Euscyrtus* sp. is now being reported for the first time in the Gryllidae. The most interesting feature of the behaviour of the sex-chromosomes is that they never associate in the prophase of meiosis. Apparently the Y does not contain regions homologous to parts of both the X's and, therefore, chiasma formation, leading to the formation of sex trivalent is impossible. The sex-chromosomes attach themselves near the two poles of the spindle, in the metaphase stage of the first division of meiosis, in such a way that during disjunction, the Y goes to one pole and the two X's to the other. The Y apparently determines the disjunction of the X chromosome complex or *vice versa*. The probable mechanism of the evolution of multiple sex-chromosomes in this species has been discussed. The spermatogonial cells of the testis and the follicular epithelial cells of the ovary show that the number of chromosomes in the species is $2n = 19$ in the male and $2n = 20$ in the female.

4. Effect of cold treatment on the frequency of non-homologous chromosome association in the grasshopper, *Catantops trisinteressonute* (Acrididae).

S. P. Ray Chaudhuri and K. K. Manna, Calcutta.

A varying number of non-homologous chromosomes in the spermatogonial and spermatocyte nuclei of untreated males of *Catantops trisinteressonute* possesses inter-chromosomal thread-like connections which are Feulgen positive. During meiosis, about 60% of the diplotene nuclei are found thus 'affected'. The total number of connections and the percentage of nuclei having associations gradually diminish with the advance of meiosis. The associations are not entirely at random, the sex-chromosomes being the main centre of association (47.9% of the association involves the sex-chromosome).

Males of the species were kept at 1°C for 72 hours before their testis were fixed for study. The data obtained conclusively prove that cold treatment increases the frequency of affected nuclei as well as the frequency of interbivalent connections in the diplotene, diakinesis and metaphase stages of meiosis. The total number of affected nuclei in the three stages in the chilled preparations is 102 out of a total of 163 (62.6%) nuclei studied as against 53 out of 163 nuclei (36.2%) in the controls.

The above results strongly indicate that the non-homologous associations are really heterochromatic association, and this is due to defect in the nucleic acid matabolism of the heterochromatin. Some of the heterochromatic segments of the chromosomes ordinarily have normal metabolism, but cold treatment perhaps interferes with the process of polymerization of the nucleic acid in these segments thus rendering them sticky. The above hypothesis helps us in explaining the increase in the frequency of non-homologous association found in the chilled preparations.

5. On the behaviour of a supernumerary chromosome in the chromosome complex of some individuals in the natural population of the grasshopper, *Aiolopus* sp. (Acrididae).

S. P. Ray Chaudhuri and G. K. Manna, Calcutta.

Two male individuals out of a total of 26 specimens of *Aiolopus* sp. examined, from the field adjoining the Biological Laboratories of the Calcutta University, contain a small extra chromosome. Its size and behaviour during meiosis in both the specimens are similar. Mitotic metaphase complement in the spermatogonial cells shows clearly 24 chromosomes instead of the usual 23 in the normal males, and the supernumerary appears a little understained. At diplotene and diakinesis the supernumerary and the X lie as univalents and often the two are very closely associated. At metaphase of the first division the former may lie either on the equatorial plate of the spindle along with the bivalents or may form an accessory plate similar to that of the sex-chromosome. When both of them form accessory plates, the supernumerary may lie either along with the X or on the opposite side of the spindle, the frequecy of the two types of arrangements being about equal. In the first division anaphase it passes undivided to one pole of the spindle and divides equationally at the second division.

6. Meiosis in the Hemipterans *Sphaerodema sp.* (Belostomatidae) and *Riptortus* sp. (Coreidae).

S. P. Ray Chaudhuri and J. Das Gupta, Calcutta.

The spermatogonial chromosome complement consists of 28 and 13 chromosomes in *Sphaerodema* sp. and *Riptorus* sp. respectively, the former having an XY

mechanism of sex-determination, the latter XO. The sex-chromosomes in both the species divide equationally in the first and reductionally in the second meiotic division. A pair of m-chromosomes characteristic of Hemiptera are present in the two species, but their behaviour during meiosis is different. In *Riptortus* the two m-chromosomes always associate at the zygotene stage and thereafter behave quite differently. During diplotene and diakinesis, in about half of the nuclei, the m-chromosome lie far apart, whereas in the other half they are associated. In spite of the above, their disjunction is quite normal and they segregate to the oppsite poles regularly at the first anaphase stage. The m-chromosomes in *Sphaerodema*, on the other hand, behave more or less like normal autosomal bivalents throughout meiosis.

7. The chromosomes in three species of Indian dragonflies.

S. P. Ray Chaudhuri and J. Das Gupta, Calcutta.

The diploid chromosome number in the males of *Rhyothemis variegata*, *Brachydiptax sobrina* and *Neurothemis tulia tulia* are 25, 25 and 28 respectively. The last named species have an XY mechanism of sex-determination, whereas in the other two it is XO. The second meiotic division is reductional for the sex-chromosomes in all the three species.

8. Responses of the genital system of female spotted munia, *Uroloncha punctulata* (Linn.) to *a-estradiol* benzoate.

Amiya B. Kar, Calcutta.

Intramuscular injections of *a-estradiol* benzoate (125) R. U. daily) into juvenile Spotted Munia, *Uroloncha punctulata* (Linn.), induced considerable hypertrophy of the oviduct. Concomittant with the precocious enlargement, the oviduct showed pronounced histological changes. Stratification and ciliation of the epithelial layer of the mucosa were experimental alterations of considerable interest. The mucosal folds were extremely prominent; the tubular glands were greatly developed; the connective tissue stroma and the muscular layers were greatly hypertrophied. Hyperemia was definitely indicated. The ligaments of the oviduct were greatly enlarged in the treated birds and exhibited thick muscular bundles. The ovaries were not affected by estrogen treatment. This lack of action of the hormone on the ovary is explained on the basis of non-involvement of the pituitary.

9. On a *Monocercomonoides nimiei* n. sp., from the caecum of Indian Guineapig, *Cavia cutleri* Bennet.

D. K. Ray, Mukteswar.

A new flagellate *Monocercomonoides nimiei* n. sp., is described from the caecum of *Cavia cutleri Bennet*. Flagellates are round or oval in shape, 3 11 in length and 1.5- 45 in breadth. The pellicle is thin. The nuclear membrane is not prominent while the karyosome is distinct. Two blepharoplasts are situated on either side of the nucleus and are connected with each other by a paradesmos. From each blepharoplast originate two flagella. The fourth flagellum is longer than the rest, and both in the fresh and stained specimens is found to be trailing behind. A siderophilic axoneme originates from the blepharoplast (which also gives origin to the trailing flagellum), passes posteriorly and sometimes extends beyond the body. In silver preparations a dot-like parabasal body was found to be situated on the lower side of the nuclear membrane. A structure similar to "Pelta" of trichomonads was also encountered for the first time in the flagellates of the genus *Monocercomonoides*.

10. On a new flagellate *Prowazekella hareni* n. sp., from the caecum of Indian Guineapig, *Cavia cutleri* Bennet.

D. K. Ray, Mukteswra.

In the caecal material of Indian Guineapigs, *Cavia cutleri* Bennet, a new flagellate, *Prowazekella hareni* n. sp., was encountered. In fixed and stained preparations the body of the flagellate averages 9.5 × 2.9 . At the anterior end there is a small protruberance where the blepharoplast is situated and from which the two flagella arise. The anteriorly directed flagellum is much thicker than the one directed posteriorly.

Both the flagella are of equal length and correspond to the length of the body. The "Pelta" is situated just below the blepharoplast as a horizontal rod-shaped structure. It is for the first time that "Pelta" has been encountered in the flagellates of genus Prowazekella. The ring-shaped parabasal body is placed just above the nucleus. The rhizoplast passes through it to the nuclear membrane. The nucleus is situated at the anterior end; it contains several chromatinic granules, while the nuclear membrane is not prominent. The cytoplasm is alveolar, with a thin pellicle.

11. On a new Coccidium, *Eimeria petauristae* n. sp., from the intestine of Himalayan Flying Squirrel, *Petaurista inornatus*, (Geoff.).

H. N. Ray and Harbans Singh, Mukteswar.

A new coccidium, *Eimeria petauristae* n. sp., is described from the Himalayan Flying Squirrel, *Petaurista inornatus* (Geoff.), The *Oocyst* is flask-shaped and is covered with a thick and rugged outer covering which is deep brown in colour. It is 46.25—52.5 long and 35.0—40.0 μ broad. The oocystic residue is small and central in position. The anterior end of the oocyst is drawn out in a short neck-like elongation and shows a dome-shaped pseudomicropyle. The dome of the micropyle often projects beyond the thick outer covering. When freed from the outer covering, the oocyst is colourless. Sporocysts are naviculoid in shape with one pole slightly broader than the other. There is no polar, papilla. Each sporocyst is 27.5—31.25 long and 8.75—10.0 broad. The sporocystic residue is large as compared to the oocystic residue. The sporozoites are elongated, with a broad anterior pole containing a few refractile granules. When treated with trypsin the sporocyst gave way at the narrow pole and the sporozoites wriggled out with this broad end uppermost. Attempts to infect rabbits with *E. petauristae* n. sp. gave negative results. Saturated sugar solution, saturated salt solution and zinc sulphate failed to float up successfully the oocysts of this coccidium.

12. Some new species of Cestodes of the marine fish *Rhynchobatus djeddensis* (Forsk) from Bombay.

D. V. Bal and F. S. Khambata, Bombay.

Specimens of *Rhynchobatus djeddensis* from the Bombay waters were heavily infected with parasites and contained, in the spiral valve, many species of Nematodes, Cestodes and Trematodes. Of these, the first two were more abundant.

The Cestodes, which have been studied during the last three years, consist of 25 species. Twelve of these species, belonging to the following six genera, appear to be new to science and are described in this paper:—1. *Tetrarhynchus* Rudolphi, 1809. 2. *Tentacularia* Bosc, 1797. 3. *Phyllobothrium* van Beneden, 1850. 4. *Echeneibothrium* van Beneden, 1850. 5. *Acanthobothrium* van Beneden, 1850. 6 *Tylocephalum* Linton, 1890.

13. Occurrence of Polychaetes in fresh water in the river Godavari.

K. H. ALIKHNI, Madras.

Records of purely freshwater Polychaetes are rare, though several species are known to inhabit backwaters and estuaries and tolerate extreme fluctuations in salinity. While investigating the fisheries of the river Godavari during July 1948, a single specimen of *Nereis* sp. and seven specimens of *Nephthys* sp. were collected in fish fry nets, the former at Kotipalli (15 miles from sea) and the latter at Rajamundry (60 miles from sea) and Polavaram (84 miles from sea). The river was in spate, with turbid water and the worms were apparently swimming with the current. The physico-chemical conditions of the water at the time of collection and on previous occassions when the localities were visited, were recorded. The water at Polavaram and Rajamundry is completely fresh all the year round, and the occurrence of these worms, particularly of *Nepthys* sp., in purely freshwater is of interest.

14. The brood-pouch and nutrition of embryos in *Melanoides tuberculatus* (Muller).

K. RAMAMURTHY, ANNAMALAINAGAR, (S. India)

Melanoides Tuberculatus is a common Melaniid gastropod, in which the ova undergo development in a brood-pouch, the young animals coming out of the mother with a form completely resembling the adult. In gravid females the brood-pouch epithelium shows a striking transformation of its cells, which become secretory Microchemical tests show the presence of fat, vitamin C and copper in them. The cells project out into the brood-pouch and finally get detached. The brood-pouch is filled with an albuminous fluid in which float some of the epithelial cells filled with secretory globules. The nutrition of the embryos in later stages is effected by the transformed epithelial cells of the brood-pouch.

15. Diatoms in the food of the Madras Oyster, *Ostrea madrasensis*, Preston.

P. K. JACOB and M. NELLAYANDAR.

To determine the availability of food in the Ennur oyster beds and to bring out the part that the diatoms play in the Madras Oyster, regular plankton collections were made from beds, simultaneous with the examination of stomach contents of the oysters for a year. Great similarity in these two items showed that the diatoms constitute a major portion of the food of the oyster. The various species of diatoms and other microorganisms forming the food of this oyster are enumerated. The probable part that the inorganic detritus plays in the nutrition of this oyster is also discussed. The importance of diatoms as a fattening factor in oysters, as was found in the Thames and Fal Estuaries, was noticed here also.

16. Reproduction, growth and development of the Madras Oyster, *Ostrea madrasensis*, Preston.

P. K. JACOB and M. NELLAYANDAR.

The reproductive organs, spawning season and the mode of fertilization of the Madras Oyster, are described. The method used for artificial fertilization of this oyster is described and the early developmental stages up to the third day are noted. After 12 days a spat was noticed on the side of the aquarium. The characters of this spat, its subsequent growth and the temperature, pH and the salinity of the

media in which the oyster was growing were also noted. To find out the surface most suitable for spat attachment, glass, porcelain plate, wood and tiles were tried. The maximum attachment was found on wood. By erecting a concrete post on the oyster bed the place of attachment was found to be confined between high and low water, the mid tide being the place of maximum lxation; a clean surface was necessary for attachment.

17. *Two Dipteran Ectoparasites from a bat.*

D. V. Bal and F. Ahmed, Bombay.

The frugivorous Indian bat, *Rousettus leschenaulti* Desm; is found in large colonies on the Bombay and Salsette Islands. During our investigations nearly all the specimens collected were found to be heavily infested with a number of external parasites. Of particular interest were a number of flies, which are recorded to be of common occurrence under similar conditions. Two of these flies, *Eucampsipoda hyrtli Kolenati* and *Nycteribosca gigantea* Speiser, described as wingless and winged forms were taken for morphological studies and this paper deals with the external morphology of these two forms.

18. Effect fo transplantation of the physogastric queen of the termite, *Pdontermes redemannt* (Wasmann).

D. Mukerji and Prabhas Kumar Mitra, Calcutta.

Two series of experiments were carried out to note the effect of removal and subsequent implantation of the physogastric queen and king in the 'trophoric field' and in different nest, far off from the original nest. Observations indicate: (i) The presence of the implanted pair is very quickly detected in the trophoric field by the foraging batches (obviously of a different colony). (ii) Construction of a new royal chamber is immediately taken up around the implanted pair. (iii) Implantation of royal pair (from a different nest) within a new termitarium does not disturb the societal life of the latter. The implanted pair receives immediate care and attendence.

19. On the structure and post-embryonic development of the male genital organs of the Wolly Bear, *Anthrenus fasciatus* Herbst (Coleoptera, Dermestidae).

K. S. Pradhan, Banaras Cantt.

The external genitalia of *Anthrenus fasciatus* consist of an aedeagus, a pair of parameres, a basal plate and a *spiculum gastrale*. All these structures originate from a pair of primary lobes which develop from the terminal segment. Each primary lobe divides into two. The inner member of each pair fuses to form the tubular ædeagus, while the outer member gives rise to the parameres. The parameres, therefore, develop as distinct morphological entities and are not merely outgrowths of the aedeagus. The *spiculum gastrale* develops from the fused mass of aedeagus and parameres. The basal plate originates from the fused mass of the parameres when all the other elements have been formed and separated off.

Each testis consists of six cylindrical follicles. The *vasa deferentia* are evidently mesodermal in origin and extend upto seventh abdominal segment in the early stages, but in the later stages of development they extend upto the fifth segment. The accessory glands, of which there are two pairs, are ectodermal in origin and develop from the lateral ejaculatory ducts. The lateral ejaculatory ducts

arise from the median ejaculatory duct, the latter developing as an invagination of the ectoderm from the ninth segment. The terminal gonopore lies at the apex of the aedeagus.

20. On the physiology of digestion of the larva of Wolly Bear, *Anthrenus fasciatus* Herbst (Coleoptera, Dermestidae).

K. S. PRADHAN, Banaras Cantt.

The larvae of *Anthrenus fasciatus* live on scleroproteins and digest the keratin substance which forms the chief constituent of the ingested food. When the larvae feed on the coloured wool of commerce the pigment material is also absorbed but the absorption takes place only in traces, and the major portion of the pigment is passed out along with the faeces. The granular faeces contain traces of keratin and an appreciable amount of urea, uric acid, ammonia, urates, and sulphates. The phosphates are present in the excrement only when the larvae feed on horn.

Qualitative tests were made for the ferments pepsin, trypsin, erepsin, chymosin, lipase, catalase, amylase, cellulase and invertase, and the methods used in preparing the extracts for detecting them in various regions of the gut are described. The presence of the ferments trypsin, erepsin, chymosin, lipase and catalase has been detected in the region of the mid-gut. It has been concluded that the fore-and hind-guts are incapable of producing the ferments.

The nutrition of the larvae is discussed on the basis of the experimental results with respect to the chemical analysis of the faecal granules and the ferments detected in the region of the mid-gut.

21. Notes on the life-history of *Labeo calbasu* and *L. fimbriatus*.

K. H. ALIKUNHI, S. V. GANAPATI and S. NAGARAJA RAO, Madras.

The spawn and hatchlings of *Labeo calbasu* were collected in large numbers from the R. Godavari at Bobberlanka on 22-7-48, transported to Madras and reared in the laboratory. The present note supplements the recent contribution of Mookerjee & Mazumdar (1946) on the development of this carp. The *hydrological conditions* of the water during *spawning* were as follows: Colour—deep brown; turbidity 1.5 cm.; temperature—27.2°C., saturation of dissolved oxygen 83.52%; pH—8.2; and chlorides 0.1 parts per 100,000.

The age of the embryos collected indicated spawning at all hours of the day. The size of the fertilized egg varied from 5.3 to 6.0 mm. in diameter. The period of incubation was about 19 hours. The 4.2 mm. long hatchling was transparent, without pigment in the eyes, and had no mouth or pectoral rudiments The absorption of yolk was completed by the third day, when feeding commenced. All the fins were fully differentiated by the twentieth day when the fry was 16.5 mm. long. The caudal spot, which is the most characteristic feature of the fry, was conspicuous even at the 12.5 mm. stage. The peculiar pigment patterns were well laid by the twenty-seventh day when the fry was 21.5 mm. long.

The spawn of *L. fimbriatus* was collected from the Cauvery at Bhavani in June 1948, and the development followed. Its postlarval growth was elucidated by rearing the fry collected from the Godavari as well as the Cauvery.

Certain interesting observations on the relative growth of different fry of the same age and subject to identical conditions are also discussed.

22. Observations on the bionomics and post-larval development of the Carnatic Carp, *Barbus carnaticus* (*Jerdon*).

K. H. ALIKUNHI and S. NAGARAJA RAO, Madras.

This carp, which has excellent sporting qualities, is in digenous to the Cauvery system. A systematic analysis of its natural food was made and over 30 items, including aquatic macrophytes. filamentous and unicellular (green and blue-green) algale, diatoms, desmids, sulphur bacteria, planktonic crustacea and insect and fish remains, found in the gut were quantitatively estimated to ascertain the 'tastes' and 'preferences' of the species. Available data indicates attainment of sexual maturity in the first year of life, when it is only 6 to 8 inches in length. Breeding coincides with the monsoon months. A complete series of post-larval stages has been collected from the R. Cauvery. Specific characters for the field identification of the fry and fingerlings are described. Growth in lentic waters has been found to be slow.

23. Metamorphosis of *Elops indicus* Swainson, with notes on the metamorphosis of *Megalops cyprinoides*, (Broussonet).

K. H. ALIKUNHI and S. NAGARAJA RAO, Madras.

The ceptocephalus stages of *Elops indicus* and *Megalops cyprinoides* entering the backwaters from the sea were collected in large numbers at Adyar, near Madras, from 5th to 15th October, 1947.

The following are the chief features of metamorphosis in the two species: *Elops indicus*: The youngest stage collected measured 39.0 mm. long. Flat, ribbon-shaped and fully transparent, it had 62 mytomes; the embryonic fin folds were present in front of the dorsal and anal fins which were not fully differentiated. Metamorphosis was completed in the course of 20 days during which period a progressive reduction in the length and height of the body took place; a gradual loss of transparency was noticed; there was a forward migration of the dorsal and anal fins and of the vent; a noticeable increase in the size of head and accumulation of dark pigment on the snout and on the margin of the dorsal fin were characteristic.

Megalops cyprinoides: The earliest stage collected were 21.5 mm. long and had 68 myotomes; the rudiments of ventrals were present; the embryonic fin folds had disappeared and the air bladder was conspicuous. They metomorphosed in 20 days when body become opaque, shorter and less flat. A forward migration of vent and dorsal and anal fins was characteristic, as in *E. indicus*. These observations confirm those of Hollister (1939) and Chidambaram & Menon (1947).

The post-larval growth of both the species was followed and the data gathered are discussed.

24 On the spawning of carps in the South Indian rivers.

S. V. GANAPATI and K. H. ALIKUNHI, Madras.

Spawn and hatchlings of the major carps of South India have been collected in large numbers from the bigger rivers such as the Godavari, Thungabhadra, Cauvery, Bhavani and Moyar, at different seasons during the last 3 years. The conditions under which spawn was collected can be broadly classified under two heads—flooded and non-flooded. The quality of spawn collected and the physico-chemical conditions existing in the river at the time of collection .are described. It is shown that *L. vonsius* could spawn in the Cauvery, Bhavani and Moyar at temperatures of 22.3—24.6°C., pH. of 6.6—7.8, and at different times of the day. Likewise,

L. fimbriatus, Labeo sp., *Cirrhina reba, Garra lamta,* and *Bagarius* sp., spawn in turbid and non-turbid waters equally well. The water was never of found supersaturated with dissolved oxygen. Neither turbidity, temperature, pH., nor dissolved oxygen, therefore, seems to be of any special significance in inducing spawning of these carps. The availability of suitable spawning grounds, either in the river or outside, during the right season when the fish is sexually ripe, appears to be the chief factor responsible for spawning.

25. Experiments on the acclimatisation of saltwater fish seed to freshwater.

S. V. Ganapati and K. H. Alikunhi, Madras.

Job & Chacko (1947) while briefly indicating the prevalent practice, in Madras, of the acclimatisation of saltwater fish seed to freshwater, have not detailed the exact physico-chemical conditions of the water. An attempt is made in the present paper to elucidate the physico-chemical variables in the medium during the several stages of transition from salt to freshwater. Details of laboratory and field experiments, carried out during the last 3 years, in respect of early fingerlings of mullets (*Mugil cephalus* and *M. schelii*), *Megalops cyprinoides* and *Elope indicus* (leptocephalus and later stages), *Gerres filamentosus, Scatophgus argus, Sillago sihama, Hemirhamphus gaimardi* and *Ambassis* sp. are given in the paper.

In the *early post-larval stage,* most of the above fishes possess the capacity for quick adaptation to wide and sudden fluctuations in salinity and other environmental conditions; but advanced stages (2 to 3 inches long) of at least *Megalops* and *Elops* are found to be more susceptible to changes, resulting in considerable mortality. The knowledge that these fish seeds at this early stage can withstand even direct transference from brackish to freshwater has a vital bearing on the possibilities of their successful culture in freshwater. Their small size and absence of mortality during acclimatisation would enable transport of large numbers at relatively low cost.

26. Factory effluents from the Mettur Chemical and Industrial Corporation Ltd., Mettur Dam, and their effects on the fisheries of the river, Cauvery.

S. V. Ganapati and K. H. Alikunhi, Madras.

Since the construction of the Mettur Dam it has become an annual feature that a series of connected rock pools are formed in the bed of the Ellis surplus course when the water ceases surpulssing. Thousands of carps and catfish are then entrapped in these pools. The factory effluents from the Mettur Chemical and Industrial Corporation are at present discharged into these pools. These effluents consist of an excessive amount of dissolved and insoluble solids, chlorides and free chlorine, and are highly alkaline due to the caustic lime used in the manufacture of bleaching powder. Since the pools are stagnant, the addition of these toxic wastes pollutes the waters and invariably results in large-scale mortality of the trapped fish during the summer months. With the Ellis surplus functioning, the pools overflow and the pollutional wastes are considerably diluted and rendered harmless to fish life.

With a view to prevent this annual mortality and the consequent depletion of the fish stock in the conserved area, the conditions of the pools were investigated at different seasons during the last 3 years. While biotal life was not altogether absent in the pools even under extreme summer conditions, those receiving direct discharge of the wastes and the neighbouring ones with their offensive odour were totally unfit for fish life of any kind.

Chemical treatment of the effluents and dilution before letting into the pools proved ineffective and uneconomical. Since excessive dilution appears to be the easiest method to render the effluents innocuous, diverting the same to the main river to a spot close to the tail race of the Mettur Power House is suggested.

27. Hydrobiological notes of the river Cauvery at selected fishing centres in the Madras Presidency.

S. V. GANAPATI and K. H. ALIKUNHI, Madras.

The river Cauvery, with its major tributaries like the Moyar and the Bhavani, yields about two-thirds of the annual revenue derived from inland fishery sources in the Madras Presidency. Important fishery centres along the Cauvery system like Theppakadu and Poongar along the Moyar; Mettupalayam, Poongar, Satyamangalam and Bhavani along the Bhavani; and Hogainkal, Mettur, Bhavani, Upper Anicut, Grand Anicut and Lower Anicut along the main river, were visited on one or more occasions during different seasons, and the conditions existing there were studied. The qualitative and quantitative nature of fish congregations in these centres and the stage of maturity of the gonads have been correlated with the physico-chemical and other ecological data.

28. Conditions of existence in some fish farms and ponds in the Madras Presidency.

S. V. GANAPATI and K. H. ALIKUNHI, Madras.

Hydrobiological and ichthyological studies of the fish farms and ponds under the control of the Madras Fisheries Department were made during the last 3 years (1945-48). Different types of waters, wherein particular species of fish appeared to grow more satisfactorily than others, were encountered during these observations. An attempt has been made in the present paper to classify these waters on the basis of certain physico-chemical and biological traits such as colour, hydrogen-ion concentration and phytological constituents. The species of fish best suited for the different types of waters have also been indicated.

29. The food of some post-larval Clupeoids.

D. V. BAL and S. V. BAPAT, Bombay.

The stomach contents of the post-larvae of the following species were examined:- *Megalops cyprinoides, Chatoessus nasus, Engraulis hamiltoni, E. purava, E. commersonianus, E. tri, E. dussumieri, E. kammalensis, Coilia dussumieri, Clupea lile, C. brachysoma, C. kunzei, C. toli, Pellona brachysoma, P. elongata, P. motius* and *P. filigera.* All except *Clupea toli,* were found to be carnivorous. *C. toli* appears to be omnivorous, as an appreciable quantity of diatoms was in the stomach. *Chatoessus nasus* and *Clupea kunsei,* which were mainly obtained from Mahim Creek, contained a large percentage of sand and mud, thereby indicating bottom-feeding habits. The early stages of most of these species feed mainly on Copepods, whereas the more advanced stages take to larval prawns, Amphipods, Gammarus, etc. The stomatchs of *Chatoessus nasus* and *Clupea lile* are muscular, as in the Mugils.

30. The food-habits of some young Sciaenids.

D. V. BAL and S. V. BAPAT, Bombay.

The food-habits of the post-larval stages of 4 species, namely *Sciaena miles, S. albida, S. glauca* and *S. semiluctosa* and of *Otolithus argenteus* were studied. Generally,

the young forms are voracious feeders, as the stomachs of the majority of the specimens were gorged with food. All the species appear to be carnivorous as no trace of herbivorous food like diatoms or algal matter was found. The earlier stages, measuring upto 75 mm. long, feed mostly on prawn larvae while the more advanced stages take larger and coarser food like crabs, Stomatopod larvae and food fish; the percentage of fish food is higher in the older stages.

31. Inland fisheries of Kodinar.

T. V. R. PILLAY and J. S. SHAW, Okha and Kodinar.

Investigations conducted during 1947-48 showed that creeks and backwaters form the most important type of inland waters and fishing is done here by the Kharvas and Kolis of Vanakbara, Kotds and Velan with cast nets, drag nets, gill nets and traps. 17 species of fish were collected. The Chikkhli and Velan backwaters are ideal sites for the opening of fish farms and oyster parks. A farm will soon be started at Velan for the culture of oysters, mullets, pomfrets and the Indian Salmon. Experiments were successfully conducted in acclimatization of the fry of *Stromateus cinereus*, *S. sinensis* and *Parastromateus niger* to brackish and fresh water conditions.

Of the five small rivers flowing through Kodinar, the Shinghoda is the most important. 8 species of fish were found in this river in its upper reaches, and 15 from the estuary. The fry of *Labeo boggut* are available in the river after the monsoon, and they can be utilised for pond culture. The young ones of *Stromateus cinereus* are seen in the estuary from December to May, and this will serve as a source of seed supply for the proposed Velan Farm. The presence of young ones of *Hilsa ilisha* in the estuary tends to prove that they ascend the river and breed in the estuary.

The ponds in the *taluka* are mostly seasonal; the perennial ones are the temple tanks where the religious susceptibilities of the villagers prevent any fishing. Anti-malarial fish culture is the only activity which is likely to receive public co-operation. Exotic fish will have to be introduced for the purpose as local larvivorea are not efficient enough.

32. On the nutrition of the young stages of certain estuarine fishes of Madras.

P. I. CHACKO, *Madras.*

The salient features of the food and feeding habits of the fry and fingerlings of 14 species of estuarine fishes of Madras are: (1) *Elops saurus*: Feeds on crustacea, like *Acetes*, young *Penaeus, Rhopalophthalmus, Leucifer* and *Mysis;* and on young *Stolephorus* and *Gobius*. (2) *Megalops cyprinoides*: Is mainly a plankton feeder on micro-crustaceans and diatoms. (3) *Chanos chanos*: Feeds on planktonic organisms like microcrustacea, diatoms, larval bivalves and gastropods, and also on filamentous algae. (4) *Lates calcarifer*: Is markedly piscivorous and feeds on *Stolephorus, Spratelloides, Gobius* and *Oryzias*; also on shrimps and young prawns. (5) *Lutjanus lineolatus*: Its food habits are similar to that of *Lates*. (6) *Ambassis commersoni*: Is a pure plankton feeder. (7) *Therapon jarbua*: Is omnivorous; feeds on Polychaetes, shrimps, young prawns, filamentous algae and insect larvae. (8) *Diagramma crassispinum*: Its food consists of shrimps, young prawns, filamentous algae and larval worms. (9) *Gerres filamentosus*: Fragments of molluscan shells and Polychaete worms form its chief diet. (10) *Scatophagus argus*: Algal matter, microcrustacea and diatoms are eaten. (11) *Sillago sihama*: Is omnivorous; consumes

Polychaetes, Amphipods, shrimps, young prawns, and algal filaments. (1) & (13) *Mugil dussumieria* and *M. ocur*: Are mainly plankton feeders. (14) *Etroplus suratensis*: Feeds mainly on algal filaments and diatoms; microcrustacea and Protozoa are also consumed.

33. Bionomics of the Indian Paradise Fish, *Macropodus cupanus* in the waters of Madras.

P. I. CHACKO, Madras.

Macropolus cupanus (*Cuv. & Val.*) grows to a maximum length of 90 mm. in the Madras waters. Its food consists of desmids and diatoms (35%), filamentous algae (20%), microcrustacea (20%), protozoa (5%), insect larvae (15%), and sand & debris (5%). It attains maturity when 8 months old when it is 40 mm. long. It breeds throughout the year, with maxima in April and September. During the breeding period the male is brightly coloured, and has elongated dorsal and anal fins. 200 to 300 eggs are laid after courtship lasting 30 minutes, in a bubble-nest amidst floating or emergent vegetation. The fertilised egg is 1.0—1.25 mm. in diameter. Embryonic development lasts nearly 3 days. The hatchling is 2.5 mm. long, and remains attached to vegetation; it becomes free-swimming on the third day. Adult characters are attained within 4 weeks, till which period the male takes care of the brood. The species is pugnacious and attacks and kills minnows, but do not feed on them. Under laboratory conditions it consumes 480—620 mosquito larvae. It is suitable for anti-mosquitoicidal purpose in paddy fields, ditches and swamps. It is hardy, is capable of withstanding climatic and environmental changes, and can be successfully transported to distant places.

34. Bionomics of *Lepidocephalichthys thermalis* (Cuv. & Val.) in the Madras waters.

P. I. CHACKO, Madras.

This fish grows to 70 mm. and feeds on: (1) filamentous algae such as *Chaetophora, Cladophora, Microspora, Nostoc, Oedogonium, Oscillatoria, Spirogyra* and *Ulothrix* (70%); (2) desmids and diatoms like *Amphora, Closterium, Cosmarium, Cyclotella, Diatoma, Desmidium, Fragilaria, Gyrosigma, Navicula, Nitzschia, Pinnularia, Stauroneis, Suriella, Synedra* and *Tabellaria* (20%); and (3) Protozoa, microcrustacea, rotifers and sand-grains (10%). It attains maturity when 50 mm. long. The female carries 200-300 eggs which are 0.7—0.8 mm. in diameter. The inner pectoral ray of the male is developed as a flat spine. During the breeding season (October—January) the fish swarms in shallow areas covered thickly with *Spirogyra* and other filamentous algae. Spawning occurs during the early hours of the day. Fertilised eggs are pinkish, 0.9—1.1 mm. in diameter, and remain attached to the algae. Embryonic development is rapid, and hatching takes place on the third day. The larva, which is 3 mm. long grows rapidly and attains adult features within a month. The swarming habit during the breeding period are taken advantage of by the rural people for collection of the fish for consumption.

35. Migratory Governments of fishes of the Coleroon.

P. I. CHACKO, Madras.

The lower reaches of the Coleroon river is subject to tidal influence to a distance of 25 miles from the sea, and is frequented by 49 species of saltwater fishes. Of these, *Mugil boornensis, M. olivaceus, Lates calcarifer, Polynemus tetradactylus* and *Therapon jarbua* ascent further into freshwater area up to the Lower Anicut (33 miles), *Hilsa ilisha* and *Etroplus suratensis* up to the Upper Anicut (110 miles), and *Megalops*

cyprinoides up to the Mettur Dam (250 miles). The important freshwater species which show local movements within the river are *Catla catla, Labeo fimbriatus, Cirrhina cirrhosa, Wallagonia attu, Callichrous bimaculatus, Pangasius pangasius, Mystus aor, M. seenghala* and *Notopterus notopterus.* The existing and proposed conservancy operations, including the provision of a fish-ladder in the Lower Anicut are discussed.

36. Observation on fishes of the Vellar Estuary, Porto Novo.

P. I. CHACKO, Madras.

The fishery of the estuary which is subject to tidal influence throughout the year, is mainly contributed by 100 species of fish, 5 of Crustacea and 5 of Mollusca. The occurrence of marine forms like *Carcharias melanopterus, Zygaena malleus, Trygon, uarnak, Osteogeniosus militaris, Sardinella brachysoma, Pellona brachysoma, Chatoessus chacunda, Engraulis malabaricus, Belone strongylura, Hemirhamphus xanthopterus, Holocentrum rubrum, Caranx hippos, C. sansun* and *Chorinemus moadetta,* and of freshwater species like *Wallagonia attu, Callichrous bimaculatus Pangasius pangasius, Silundia sykesii, Mystus aor, M. seenghala, Labeo fimbriatus, L. kontius, Cirrhina cirrhosa, Catla catla, Danio aequipinnatus, Rasbora daniconius* and *Chela sardinella* are of special interest.

A census of the fisherfolk, crafts and tackle and the existing marketing arrangements, the availability of facilities for estuarine farming and seed collection are indicated. The suitability of the area for the establishment of an estuarine biological station is discussed.

37. Fisheries of the Upper Godavari, with special reference to the Ramapadasagar Project.

P. I. CHACKO, Madras.

78 species of fishes have been recorded from the upper Godavari. The similarity of this fish fauna to that of the Krishna and the Tungabhadra is explained by the conditions of their sources and country (the Deccan) through which they flow. The spawning grounds of the carps, particularly the mahseer, and of the Siluroids are indicated. The shad, *Hilsa ilisha,* runs up to the Dummagudem Anicut, a distance of 210 miles from the sea. The Ramapadasagar Project, which is about to be executed across the river, consists of a dam one mile long and 200 feet above the river bed. The reservoir would cover 527 sq. miles. The fishery problems arising out of this project by obstruction of free passage of fish, moderation of flow of water, and the formation of the reservoir and canal systems are discussed. A fishery station, with a programme for conservancy, cultural, developmental and harvesting operations is being established. The provision of a fish ladder of suitable gradient is also being considered.

38. The Krishna river and its Fishes.

P. I. CHACKO, Madras.

The Krishna river has a course of 250 miles in the Madras Presidency. The first 150 miles run through deep gorges and forest areas. 87 species of fish occur in this stretch, and contribute to a fishery similar to that in the Tungabhadra river. The lower reaches of the river are subject to tidal influence up to 35 miles from the Bay of Bengal. 65 marine and estuarine species of fish similar to those in the tidal zone of the Godavari, have been recorded from here. 8 species of Crustacea also contribute to the commercial fisheries of the estuary. *Hilsa ilisha, Lates calcarifer, Sciaena belangeri* and *Mugil*

olivaceus ascend the river to a distance of 30 miles beyond the tidal zone, the first species for spawning and the others for feeding. 27 spawning and nursery areas of carps and other freshwater species are located for collection and distribution of fish-seed to other inland waters. Statistics of 714,750 fish-seed so far collected and stocked are given. The presence of fingerlings of saltwater species of the genera *Mugil, Megalops, Lates, Polynemus* and *Lutjanus* in the estuary and their suitability for acclimatisation and rearing in freshwaters of the Godavari and Krishna districts are discussed. The need for more stringent measures for conservancy of spawners and young ones, and for the introduction of the 'Pearl Spot,' *Etroplus suratensis,* in the estuary are indicated. The occurrence of *Cirrhina mrigala* in this river is detected for the first time.

39. Fish and fisheries of the Muthuppet Saline Swamp, Tanjore District.

P. I. CHACKO, Madras.

The Muthuppet Swamp, 200 sq. miles in area, has direct connection with the Palk Strait along a narrow seaboard of 30 miles. 5 small rivers empty into it. 89 species of fishes and 8 of Crustacea contacea contribute to a perennial fishery here. Mullets and *Etroplus suratensis* breed within its limits. *Lates calcarifer* and *Polynemus tetradactylus* breed in the inshore area of the adjoining sea from October to December, and their young ones migrate into the swamp for shelter, feeding and growth. Fingerlings of *Chanos chanos* and *Megalops cyprinoides* also occur in the swamp. A fish farm and nursery have recently been established in a nearby area to exploit these fish seed sources for the stocking of inland waters.

40. Preliminary report on the fishery resources of the Bhavani river in relation to the Lower Bhavani Project.

P. I. CHACKO and P. DINAMANI, Madras.

The Bhavani river flowing through the Coimbatore district, is subject to both the monsoons. It is an important river-stretch, containing 75 species of fish, most of which find spawning and nursing facilities in it. *Barbus tor, B. hexagonolepis, B. carnaticus, Cirrhina cirrhosa, Labeo fimbriatus, L. ariza, L. boga, L. kontius, Wallagonia attu, Macrones aor, M. seenghala, Pangasius pangasius, Silundia* and *Notopterus* sp. are the chief species spawning in the river. A masonry dam, 8 furlongs long and 125 feet high, is to be constructed across the river near the Pungar village, to form a reservoir about 32 sq. miles in area. Considerable hydrographical and biological changes are expected both up and down stream in the dam, adversely affecting the important fluviale fishery. A programme of fishery management, consisting of conservation, cultural operations, judicious exploitation of the reservoir, provision of fish way, and research and investigation is detailed.

41. An ecological reconnaisance of the fishes of the Red Hills Lake.

P. I. CHACKO and P. DINAMANI, Madras.

The Red Hills Lake, about 8 sq. miles in area, situated on the outskirts of Madras City affords facilities for fish production. The physical, chemical and biological conditions of the lake are detailed. 42 organisms occur in its plankton. 40 species of fishes are listed. *Etroplus suratensis,* which was stocked by the Fisheries Department, has bred and multiplied, and contributed to a good portion of the existing lake fishery. *Megalops cyprinoides* occurs in good numbers during the rainy season. The fish fauna is otherwise poor in quality, and lacks in major carps and siluroids. A programme of

stocking with species like *Catla, Mrigal, Gourami, Barbus dubius, Chanos,* etc., conservation, exploitation and marketing is outlined.

42. Notes on *Hilsa kanagurta* (Bleeker) and *Hilsa toli* (Cuv. & Val.)

P. I. CHACKO and B. KRISHNAMURTHI, Madras.

The external characters distinguishing *Hilsa kanagurta* and *Hilsa toli* are tabulated. The former lives in estuaries and inshore sea, whereas the latter is a purely marine form. Both are surface swimmers and feeders; the former feeds on zooplankton and phytoplankton in equal proportions, whereas the latter feeds on zooplankton only. They prefer to feed during the early hours of the day. *Hilsa kanagurta* abstains from feeding during the spawning season (August to November). *H. toli* breeds from October to January and feeds during the period. Maturity is attained when 5 to 6 inches in length in the case of *H. kanagurta,* and 12 to 13 inches in *H. toli.* The young ones of the former associate with *Chatoessus chacunda,* and the adults of the latter with the mackerel.

43. Hermaphroditism in the Indian Shad, *Hilsa ilisha* (Ham.) .

P. I. CHACKO and B. KRISHNAMURTHI, Madras.

A specimen of *Hilsa ilisha* 17.5 in. long, 5 in. high and weighing 3 lbs. had in the anterior one-third of both of its gonads the structure of testis and the posterior two-third, the structure of ovary. It was obtained from the Godavari, delta.

44. Feeding and breeding habits of the common carps of south India.

P. I. CHACKO and G. K. KURIYAN, Madras.

Catla sp. is a surface and midwater feeder, its diet mostly consisting of vegetable matter, diatoms and desmids and microcrustacea. *Labeo fimbriatus* feeds largely on diatoms and algal matter; and *L. calbasu* on algal matter and microcrustacea. *Cirrhina cirrhosa* is mainly a plankton feeder, whereas *C. reba* feeds on algae and diatoms. *Barbus (Tor) khudree* is mostly piscivorous. Insects and insect larvae predominate in the diet of *Barbus hexagonolepis* and *B. carnaticus.* The breeding period commences by the end of May with the commencement of the south-west monsoon, and extends to the end of October. Shallow river margins and adjoining areas containing emergent vegetation or submerged boulders, with moderate flow of water, form favourable spawning grounds. The maximum spawning takes place in the first half of the season during night and the early hours of the morning. A lunar peridicity is also observed.

45. Food and feeding-habits of certain fishes of the Tungabhadra River.

P. I. CHACKO and M. J. MATHEWS, Madras.

(1) *Rohtee ogilbii* feeds mainly on plankton such as *Anabaena, Microspora, Nostoc, Cosmarium, Cymbella, Fragrlaria, Gonatozgon, Navicula, Nitzschia* and *Synedra.* (2) *Macrones vittatus* consumes insect larvae, *Gerris, Hydrometra* and microcrustaceans. (3) *Glossogobius giuris* is a predator and feeds on small species of fish such as *Chela phulo, Aplocheilus blochii* and *Barbus ticto,* and also on larval insects. (4) *Notopterus notopterus* is carnivorous and consumes fishes like *Aplocheilus blochii, Oryzias melastigam* and carp fry, and also shrimps and aquatic insects. (5) *Callichrous macrophthalmus* feeds mainly on insects, shrimps, crabs and carp minnows. (6) *Callichrous pabo* feeds on shrimps, cyprids and daphnids. (7) *Bagarius bagarius* is markedly piscivorosu and eats *Chela argentea, Chela phulo, Amblypharyngodon mola,* and fry of *Labeo fimbriatus* and *Catla.* (8) *Puntius kolus* consumes filamentous algae, diatoms, desmids and microcrustaceans.

46. Preliminary report on the fishery biology of the Tungabhadra Project, Hospet.

P. I. CHACKO and M. J. MATHEWS, Madras.

The dam under construction across the Tungabhadra is 8,200 ft. long and 150 ft. high at the deepest section. Considerable changes are expected in the fish life of the river when the project is completed. The meteorological and hydrographical conditions of the area are recorded. 66 organisms have been identified from the plankton of the river. 85 species of fish have also been recorded from this region. *Callichrous pabo* (Ham.) has been recorded here for the first time; this record is of zoogeographical interest. *Osphromenus goramy, Etroplus suratensis, E. maculatus, Gambusia affinis* and *Lebistes reticulatus* were introduced into the river in 1947 as a preliminary to development of the fluviale fisheries. The collection of fishlings from 20 spawning and nursery areas in the river for stocking lentic waters is indicated.

47. Food and feeding habits of *Labeo boggut* (Sykes).

P. I. CHACKO and (Miss) SHARADA SUBRAMANIAN, Madras.

The food consists of (1) Desmidiaceae (*Closterium, Cosmarium, Desmidium, Euastrum* and *Pleurotaenium*) (5%); (2) *Bacillariaceae, (Achnanthidium, Coccoeis, Cyclotella, Cymbella, Eunotia, Fragilaria, Frustulia, Gomphonema, Gyrosigma, Mastogloia, Melosira, Navicula, Nitzschia, Stauroneis, Synedra* and *Tabellaria*) (15%); (3) Chlorococales, (*Ankistrodesmus, Oocystis, Pediastrum* and *Scenedesmus* (5%); (4) Oedogonales (*Oedogonium*) (5%); (5) Conjugates (*Spirogyra, Microspora* and *Mougeotia*) (15%); (6) Cyanophyceae (*Anabaena, Aphanocapsa, Coelosphaerium, Cladophora, Lyngbia, Nostoc, Oscillatoria* and *Spirulina*) (35%); and (7) mnd. sand & scum (20%). The fish mainly browses on algal mater and bottom debris.

Animal matter is totally absent in its diet. Though growing to a size of 8 inches only, the easy availability of its young stages in large numbers in the Tungabhadra and Krishna drainages from July to October makes it suitable for stocking rural waters.

48. Fisheries of the Adyar River.

P. I. CHACKO and (Miss) SHARADA SUBRAMANIAN, Madras.

This Small river, 25 miles long, flowing along the southern border of the Madras City is very favourable for fishery improvement. Being subject to tidal influence for about 6 months in the year, there is a predominant marine element in the fauna of the river. The plankton consists of 52 species of diatoms, 5 of desmids, 7 of Chlorococcales, 13 of Cyanophyceae, 10 of protozoa, 11 of crustacea and 1 of mollusca. The existing fishery if poor except when the bar is open. 82 species of fishes have been recorded from the entire river stretch. The occurrence of seed of saltwater species acclimatisable to freshwater adds to the importance of the fishery. Statistics of collcetion and stocking operations are given. The food and feeding habits of ten species are described; and the larvicidal and cyclopscidal tendencies of *Rasbora daniconius, Etroplus maculatus, Ambassis nama* and *Barbus sophore* are indicated. The need for the introduction of larger carps like *Catla,* and regulation of exploitation of the fisheries in order to cater to the needs of the increasing population of the City are emphasised.

49. The morphological and histological variations of the lung in anakes.

(Miss) M. R. VARDE, Bombay.

It has been found that the lungs in snakes vary considerably. The histological study of the lungs reveals four main types. (i) The simplest type is met with in

Enhydrina valakadien in which, except for the greatly enlarged development of the investment of the muscular and connective tissue, the lung-tructure resembles that of the frog, and the alveolar elaboration is poor. (*ii*) In *Python molurus, Ptyas mucosus, Geradia prevostiana* and *Cerberus rhyncops* there is a folding of the partitions and a greater development of the alveoli. (iii) In *Naia tripudians* and *Echis carinata* the partitions are more folded and the cavities thus formed are divided into innumerable alveoli. The lateral chambers are also more numerous. (iv) In *Hydrophis cyanocinctus* the extent of the pulmonary tissue is reduced, as there are no marked subdivisions of the lateral chambers.

From the standpoint of morphology, three distinct lines of evolution are seen: (a) The simplest shows the retention of more or less the original dimensions and relations of the lung, as in *Python* in which two lungs are present. (b) The second line shows a posterior extension of the single lung present so as to form a capacious reservoir for storing up air. (iii) Its highest expression is met with in aquatic snakes such as those of the genera *Hydrophis, Cerberus, Gerardia* and *Enhydrina* and in the terrestrial genus Echis. Here an anterior extension of the lung takes place, incorporating the trachea in it.

50. The extent of development of the Premaxilla in snakes.

(Miss) M. R. Varde, Bombay.

There is considerable variation in the shape and extent of the development of the premaxilla of snakes. In some cases this variation is met with amongst the different genera of a family. The primitive form of the premaxilla among reptiles appears to be T-shaped, with an anterior broad head bearing two short lateral limbs and a conspicuously long posterior process. The premaxilla of the lizards is generally of this shape. In the primitive families of snakes such as the Boidae and the Colubridae, this fundamental shape remains unaltered. In the genus *Acrocordus* (Family Colubridae), however, the premaxilla is reduced and appears to be made up of two symmetrical pieces, one on either side. Whether this paired condition is more primitive than the triradiate single one, or is secondary, remains undecided. Form the fact that the premaxilla is double in *Sphenodon,* there is some ground for supposing that the *Acrochordus* premaxilla exhibits the ancestral condition. An intermediate condition is found in the Viperidae. In some members of the Hydrophiidae, (*e.g. Hydrophis*) the median limb of the premaxilla is reduced to a vestige, while in others (*e.g. Microcephalophis*) it assumes a more or less triradiate condition.

51. Observations on the structure of the heart of the snaks *Typhlops* sp.

Hanmesh V. Kashyap, Dhaiwar.

With a view to establish the nature of the interventricular septum in the heart of snakes, the study of the structure of the heart of *Typhlops* sp. was undertaken. The main features of the heart are as follows:—(1) The sinu-auricular aperture is obliquely transverse and its caudal valve is continued into the right auricle as a ridge. (2) Each auriculo-ventricular apeture is guarded by a single valve not fastened to the wall of the ventricle by chordae tendinae. (3) In fresh hearts the venous and arterial halves of the ventricle are indicated externally by difference in colour. (4) The interventricular septum is incomplete and is the only septum present in the ventricle, indicating that the primary function is to divide the ventricular cavity into venous and arterial halves. (5) There is present in the wall of the ventricle a cartilaginous rod which is a feature peculiar to snakes, and is recorded here for the first time.

SECTION OF ANTHROPOLOGY & ARCHAEOLOGY

PRESIDENT: PROF. NIRMAL KUMAR, M.Sc.

1. Co-ordination of Anthropological Field-work in India.

T. C. DAS, Calcutta.

The necessity of recording the culture of the backward groups for national reconstruction. Absence of any organisation for disemination of information regarding investigations undertaken by persons and institutions in different parts of the country. The necessity of co-ordination among anthropological field-investigators. Suggestions for setting up an organisation for this purpose.

2. Personality and Culture.

NABENDU DUTTA-MAJUMDER, Calcutta.

The growth of *Personality and Culture,* a new field of Anthropology, is based on the recognition of the existence of an intimate interrelationship between the cultural background and the character of individuals living within that culture. Here, the problem of great scientific importance is, not just to know that different cultures produce different personalities, but to ascertain how and why different personalities are produced in different cultures. The solution of this problem depends on a dynamic, genetic study of the child as it grows up in its socio-cultural environment.

Students of *Personality and Culture* have already developed such concepts as *communal* or *modal* and *idiosyncretic* personalities,-concepts which are extremely useful for a proper understanding of the behaviour of adult members of a socio-cultural group. Again, the dependence of our psychological reactions on the cultural background has been indicated clearly by the conclusion, reached by Margaret Mead in her genetic study of children in Samoa, that emotional storms and stresses found in adolescents in the United States are not due to the fact of adolescence, as was thought to be the case, but are culturally determined. For, in Samoan culture adolescents pass over this period without emotional difficulties.

3. A brief study of the cultural developments in India.

M. N. BASU, Calcutta.

In this short paper the writer discusses the meaning of culture introduction, the religion and ceremonies associated with it, racial contacts, study in transmutation, Bengal's culture, Sakti cult changed, and culture of different areas.

4. Korku physical type.

K. P. CHATTOPADHYAY, Calcutta.

The writer measured fifty Korkus of Melghat forest during his visits in 1938 and 1940. The measurements and indices are noted and the physical type described. There are no earlier measurements of Korkus reported.

5. The Kabui.

TARAK CHANDRA RAYCHAUDHURI, Calcutta.

The paper is based on somatomeric measurements on 100 subjects. They are short (72%) mesocephalic (62%) with a good percent (25%) of dolichocephals. The altitudinal index is variable-51% hypsicephalic and 36% orthocephalic. There is a greater variation in facial index-24% euryprosopic, 38% mesoprosopic, and 26% leptoprosopic. The nose is generally leptorrhine (64%) but as many as 34% are mesorrhine. The orbitonasal index leads us to suspect a blend of two elements—there being 35% platyopic and 47% pro-opic.

6. Possibility of a racial significance by colour preference.

M. N. BASU, Calcutta.

Feeling-tone of the Parois, Bunas, Koms, Noluas and the Bengali College Students are discussed in this paper and the writer tries to draw some conclusions from them.

7. The Somatometry of the Parois of Jessore.

M. N. BASU, Calcutta.

400 adult male subjects were measured by the writer with the help of Martin's anthropometric set including the two callipers and the results are analysed in the light of modern physical anthropology.

8. Anthropometric study on the Santal of the Santal Parganas.

P. C. BISWAS, Delhi.

The Somatometrical measurements of one hundred male Santals of the Santal Parganas mostly from Damin Area (Dumka and Godda) were taken by me to find out the physical types of the Santal. I have arrived at the following conclusion from the above measurements.

The Santals are short statured; long-headed and flat-nosed people. Their skin colour is dark-brown; hair colour, black; and hair form, wavy; body hair is scanty. Eye colour is dark-brown to black.

9. A study of the Physical Characters of the Kandhs.

G. S. RAY, Calcutta.

The Kandhs are quite well-known people in the anthropological field all over the world. They formerly used to practise human sacrifice inorder to have a bounty crop. There is some literature concerning their social and religious institutions and economic persuits; but no one has yet studied them intensively either from the cultural or from the physical standpoints.

The present paper deals with the study of their physical characters. The study was carried out on 100 individuals from nearby village of Phulbani, the headquarter, of Khondmals, in Orissa.

From the study it is found that the majority of the Kandhs are bright tawny in complexion with wavy hair. They are between short and below medium in stature. The mean stature is 159.96 cm. They are mainly dolicocephalic (mean C.I.73.57) mesorrhine (mean N. I. 77.13) people.

10. Growth and Development of Bengalee women students.

A. N. CHATTERJI, Calcutta.

The study is based on the measurements taken of 2093 woman students from Calcutta schools and Colleges. The averages together with the standard errors of height and weight, vital capacity and strength of grip (right & left) and ponderal index for age groups 10 to 20, are given. The averages are compared with the corresponding figures for Bengalee boys. The period of rapid growth is shown to be years 10 to 13. Between the ages 14 and 16 the rate of growth is slowed down and after the 16th year the increase in height is negligible, but the weight and vital capacity increase slowly till the 20th year. A comparison is made with similar figures for the English, Japanese and Philippino students.

11. Some celts and chisels from West Bengal.

D. SEN, Calcutta.

A number of ground celts and chisels has been found near Bamal on the river Kasai in the Jhargram subdivision of the Midnapur district in West Bengal. The implements have been described and the surface geology of the place discussed in the paper.

12. A Report on a further collection of Palaeolithic implements from the lateritic sites in Mayurbhanj.

D. SEN, Calcutta.

In course of a field-work in March 1948, a collection of stone implements was made from the Kuliana and Kalabaria lateritic sites in Mayurbhanj. Work was more concentrated at Kalabaria where two trial trenches were opened and a number of tools were found *in-situ*. The rest of the tools found in the lateritic pits and incrusted with lateritic nodules evidently also come from the laterites. The main tool-families provisionally identified in this collection are the hand-axes, cleavers, choppers, scrapers, borers, discs etc, besides some simple flakes. The leading tool-family is that of the hand-axe represented by a variety of types. Here we have predominatly a core-tool culture somewhat recalling the Abbevillian-acheulian. Along side the core-tools, the occurence of a few flake tools and simple flakes which recall the early clactonian type is also significant.

The tools are found in the Secondary low-level laterites generally upto a depth of 6 feet from the ground surface. They seem however to concentrate here between 1'6" and 4'. No tool has yet been found in the boulder conglomerates or any other deposits than the detrital laterites. The exact geological dating of the laterites is here a problem.

13. The Megalithic problem of Chingleput.

V. D. KRISHNASWAMI and K. V. SOUNDARA, RAJAN, Madras.

This paper brings out the nature and importance of the particular problem connected with the sepulchral megalithic structures of Chingleput District, for which the explorations conducted by the Department of Archaeology in the last four seasons, in this region have prepared the ground. It succinctly describes the mode of dispersal of these monuments in relation to geographical factors.

Certain sites like Pandur and Nanmangalam lying respectively in the northern lateritic and the southern granitic region of this district, reveal only one type of monuments prevalent namely the Cairn Circles. In the majority of cases, we find in both regions a promiscuous mingling of both the two types of monuments namely the

dolmenoid-cists and the Cairn Circles belonging to this region. We find also in a few of these mixed sites sometimes, a segregation of the two types of megaliths, as in Sirudavur, Panaiyadivakkam etc.

In the past based on sporadic observation of a few sites it had been surmised that such a separation was due to sexual classification on the one hand and a status-grouping attempted by the megalithic folk, on the other. Division on a Pallava-Chola basis was also propounded for the monuments in certain sites near Pallavaram and Chingleput.

The paper does not only show the distinct individuality in the Chingleput district of the dolmenoid-cists enclosing terracotta legged sarcophagi and their characteristic mutual association with the Cairn Circles enclosing pyriform urn burials; it also presents how the non-megalithic urn burial culture of Tinnevelly in the tip of the Peninsula has:

(1) effected a probable fusion in this region with, in the course of its northward migration the megalithic (sarcophagus) culture of Chingleput which does not go south of South Arcot and,

(2) absorbed in its turn megalithic appendages, resulting in the Cairn Circles of the region surviving along side of the dolmenoid-cist in this district.

Discussing the peripheral influences at work in this transformation, the paper deals also with the existing evidences for dating the megalithic and other sepulchral monuments of South India, which eventually will help to date the Chingleput megaliths.

14. Preservation of fabrics in Museum.

M. N. Basu, Calcutta.

25 museum fabrics made of cotton were treated by the writer in the Museum method laboratory of the Department of Anthropology, Calcutta University and the results discussed.

15. A Santal bird net.

K. P. Chattopadhyay, Calcutta.

The writer describes a hand-operated semi-automatic net used by Santals in Mayurbhanj to trap birds. The net is like an elongated cylinder in outline and kept in position by pegs. When closed by a pull of a string by the operator from a distance, two sticks hold up two sides of the trap which shut and form a cage (Illustrated).

16. Turtle Lore.

S. T. Moses, Baroda.

Definitions—Egglaying of turtles—Biomythic significance of the turtle—Tortoise and consmogony of the Hindus—Tortoise and Sathapatha Brahmahas—Taittiriya Aranyaka—Puranas—The esoteric and evolutionary interpretation of the Avatars—Gond belief about 'Genesis'—Cheros' idea of creation—American Indian beliefs—Huge sizes and longevity of these creatures are apparently the causes of these beliefs—Liberation of turtles caught—Ease in capturing Hawksbill turtles when feeding on Physalia—Turtle catching on land by 'turning it over'—Turtle deities at Sri Kurmam, Tellicherry and Nerenika—Offerrings of wooden tortoises as cure for diseases—rituals where tortoises live and images figure—Kachuga lineate because of stripes is called the mendicant tortoise—Shape of tortoise followed for seating planks for meals, marriages etc.—Yagna Kunds—Silver tortoise and foundation stone laying ceremony—Tortoise feeding at Siddhanath, Agra, Puri etc.—Mudturtles and pisciculture—Mudturtles and public health —Turtle eating—cases of fatality—turtle flesh taboo in Laccadives etc.—Tortoise flesh an invigourator and courage giver—Turtle eggs a delicacy—Turtle oil and beliefs about

uses—Beliefes about tortoises and house building—Tortoises and totems—Tortoise stories about perseverance, friendship and evils of talkativeness—Tortoise and self discipline—Tortoises in proverbs and riddles.

17. Khasi land ownership and Sale.

K. P. CHATTOPADHYAY, Calcutta.

The writer briefly describes changes in land tenure of privately owned land and the usual procedure of land sale among Khasis, aswellas how boundaries are demarcated (Illustrated.)

18. A short note on Khasi bone disposal.

K. P. CHATTOPADHYAY, Calcutta.

The writer furnishes certain details regarding the disposal of the bones of a cremated person, when the full formal ritual is not performed at the burning of the dead body. Now-a-days deviations from the full rite is usual and the writer notes the procedure followed in such case. (Illustrated).

19. The Concept of After-life among the Adibasis of India.

T. C. DAS, Calcutta.

Concept of the soul among the Adibasis of India. The 'other world', its situation and nature. How far life in this world affects life in the other. The concepts of sin and retribution among the Adibasis. Influence of Hinduism. Effects of these ideals on the practical life of the Adibasis.

20. Blood and the Primitive.

(Mrs.) HILDA RAJ,

General attitude of the primitive to blood, and beliefs arising therefrom.
Animal blood, human blood.
Blood of man, of woman. Blood of kings and priests.
'Blood is life'. Transmission of life strength and courage through blood.
'Blood, a vehicle of contagion. Transmission of impurity, weakness, cowardice-source of danger.
Blood as a bond of brotherhood and love.
Practices-blood used for purification-in fertility rites-in medicine-for magic-for contracts.
The ceremonial pouring on of blood.
The ceremonial drinking of blood.
Taboos attached to blood.
Symbolism.
Interpretation.

21. Suggestions for improving human relations in Indian Industries.

J. K. BOSE, Calcutta.

In this paper a conciliation machinery has been suggested to develop good relations in the Indian Industries.

22. Metopism in Bengali Skull.

R. N. BASU, Calcutta.

Observations and meansurements of 200 Skulls, were made and the data collected.

36TH INDIAN SCIENCE CONGRESS: ALLAHABAD: 1949

ABSTRACTS

(Advance Issue)

SECTION OF MEDICAL & VETERINARY SCIENCES

President : Dr. M. B. Soparkar, M.D., B. Hy., F.N.I.

MEDICINE AND PUBLIC HEALTH

1. On the Seasonal Variation of some common skin diseases as seen in the Out-patient Department of the School of Tropical Medicine, Calcutta.

L. M. Ghosh, Calcutta.

This is an observation on the seasonal variation of six common skin diseases namely—Allergic dermatitis, Impetigo contagiosa, Lichen planus, Psoriasis, Ringworm and Scabies as seen in the out-patient department of the School of Tropical Medicine, Calcutta.

The skin out-patient department of the School having an attendance of 10,000 or more new skin cases every year may rightly claim to give an average good figure for analysis. It attracts patients both from the city and the surrounding suburbs so that the figures may be taken to represent the incidence of the diseases in this part of the country. The analysis has been based on the observation from the attendance of the patients in four years. The result may be briefly stated as follows :—

There is distinct significance in the seasonal variations of three diseases namely Psoriasis, Ringworm and Scabies. The incidence of psoriasis is higher in winter (from November to February) and in the dry summer months from March to June. The incidence of ringworm is higher in the humid months of July to October and scabies occurs more in the winter months from November to January.

2. Fluorine—Its effect on Enamel of Teeth and on Prevention of Dental Caries.

M. B. Daver, Hyderabad—Deccan.

Chronic Fluorine intoxication is wide-spread in the Nizam's Dominion.

Fluorine content of water less than one part per million appears to be innocuous. Above this threshold, it produces various manifestations of Fluorine intoxication.

The various manifestations of enamel of teeth, vary according to the concentration of fluorine.

Fluorine concentration not much above its threshold has preventive action on caries of teeth ; provided the child had come to live in fluorine area, before the age of six.

Incidence of dental carries and number of cavities per child was less in those who consume water containing higher fluorine concentration.

Mottling of teeth and incidence of caries were more amongst those who were poorly fed and mal-nourished.

Figures are given showing the percentage of freedom of caries, number of cavities per child and average caries figure for various comparable groups examined in India.

3. Viability of Cholera Vibrios in Chlorinated and Non-chlorinated Waters and Alcohols.

G. Panja, Calcutta.

In tap waters of Calcutta (pH 8.3 to 8.1), vibrios are viable upto 20 hours and rarely upto 48 hours. In deep tubewell water (pH 7.7) viability is seen upto 96 hours as a rule but in shallow tube well waters (pH 7.9) vibrios are killed in 4 hours whereas in unfiltered Hooghly river water, the organisms are viable for much longer time, uptill 48 hours and nonviable after 96 hours.

In chlorinated tap water, 2 per mille, vibrios are viable for 15 seconds only and become non-viable in 30 seconds. In strength of chlorine 1 per mille, viability persists for 1 minute and in strengths from 0.2 to 0.1 per mille, viability is maintained for one to two hours. It is therefore desirable that our drinking water should be chlorinated at least 1 per mille.

In alcohols, 3 to 5 per cent, vibrios are viable for 15 minutes but non-viable in 30 minutes. In gin diluted 1 in 2, vibrios are killed in one minute but when diluted 1 in 4, the organisms are viable for 4 minutes and in beer diluted 1 in 3 the vibrios survive for one minute only and are killed in 2 minutes. This shows that a drink of alcohol after an infected meal may eliminate the vibrios.

All the viability experiments with the above fluids were conducted at room temperature.

4. A case of a Cholera-Carrier.

G. Panja, Calcutta.

Very few cases of true cholera carriers are on record.

An eosinophilic lung case, gives no history of past cholera nor any bowel trouble but gives history of contact only one year ago. Cholera vibrios were isolated from the stool on 2 consecutive days and none were found in the next two days' examination. Blood showed agglutinin to the titre of 1 in 160. It is presumed that the patient was harbouring the bacilli in gall bladder and there was periodic discharge of vibrios from the gall bladder into the gut.

5. Viability of the Cholera Vibrio in the Body of the Common House Fly.

M. B. Soparkar, Bombay.

With the object of studying the role of the common house fly (Musca domestica) in the spread of cholera experiments were undertaken to determine the length of time during which the cholera vibrio remains viable in the body of the fly after its ingestion.

Laboratory bred flies fed with a mixture of sterilised milk and a suspension of young culture of cholera (Inaba strain) were dissected at intervals varying from 2 hours to nine days and their gut contents examined culturally for presence of cholera vibrios.

Of over 1050 flies fed in a series of 22 experiments 522 were examined. Of the 45 flies examined within 2 to 8 hours after feeding nearly 50 per cent (22) showed viable cholera vibrios. Beyond this interval, however, upto nine days none of the remaining 477 flies examined showed a positive result except in only one instance out of 101 flies examined 24 hours after feeding.

In another series of 29 experiments to study transmissibility dejecta of 150 flies were examined at varying intervals. Cultural examination of their dejecta deposited at intervals from 1 to 12 hours after infective feed showed viable cholera vibrios in 32 out of 90 flies examined. In the remaining 60 flies further examination after 12 hours upto six days showed no cholera vibrios except again in one instance—24 hours after feeding (1 out of 12).

The results indicate that the common house fly remains infective for only a few hours after feeding on matter containing cholera vibrios.

6. On a Bactericidal Principle for Cholera Vibrios found in the Body of the Common House Fly (Musca Domestica).

M. B. Soparkar, Bombay.

In experiments reported in another paper it was shown that the cholera vibrios when ingested by the common house fly at a single feed were either rapidly excreted or were destroyed in the gut of the fly.

Experiments were made to examine if the gut of the fly had a destructive effect upon the cholera vibrio.

An extract of the dissected out crop and intestine or even of the whole abdomen of the fly made with tyrode solution when mixed with a suspension of cholera vibrios was found to destroy them and render the mixture sterile suggesting the presence in the body of the fly of a bactericidal principle. Study of some of the properties of this principle brought out the following among other points.

That the principle acted quantitatively and had also a time factor.

That it could withstand a temperature of 115°C. under pressure.

That it was not heat coagulable.

That it was soluble in water but insoluble in acetone and ether.

That it was not precipited by phosphotungstic acid.

That it was dializable.

That it had a selective action on vibrios—both agglutinable cholera vibrios as well as non-agglutinable water vibrios but had not the same bactericidal action on other organisms tested e.g. B. typhosus, B. dysenteriae, Flexner and Shiga, B. coli and Staphylococci.

The action of the bactericidal principle is demonstrated by the fact that when 0.5 c.c. of the dialisate of the fly extract was mixed with a suspension of five million cholera vibrios and incubated it was capable of destroying them and rendering the mixture sterile in fifteen minutes while the non-dializable portion of the extract when similarly treated showed profuse growth of cholera vibrios even after 48 hours of contact.

Much further work will be necessary to determine the precise nature of this bactericidal principle.

7. Summary of Experimental Work on the Derivatives of Diamino-Diphenyl Sulphone in the Treatment of Leprosy.

R. G. Cochrane, Chingleput, Madras.

Much work has been done on the Sulphones within recent years. It is now possible more accurately to assess the value of these remedies. Recent work indicates that the Sulphone drugs act largely by virtue of the fact that they are concentrated in the tissues, particularly the skin. In order to compare the efficacy of the sulphones with Hydnocarpus Oil a standard must be set up. It is suggested that workers conducting therapeutic trials by the Sulphone derivatives should adopt a method of recording which will enable them compare the relative efficacy of these drugs with the Hydnocarpus (Chaulmoogra) remedies or any other remedy which may show promising results. The method of estimating a bacteriologic index for this purpose is described.

The individual Sulphones now in use are detailed and their methods of administration and relative efficacy compared. A plea is made to exercise great caution in claiming success for this treatment, although admittedly the sulphone remedies appear superior to any other treatment in advanced lepromatous leprosy. It is suggested that until a suitable Sulphone is discovered which can be injected by subcutaneous or intramuscular injection, these remedies cannot be used at present for mass treatment.

8. Significant factors in the Epidemiology of Leprosy with particular reference to South Indian Conditions.

R. G. Cochrane, Chingleput, Madras.

The epidemiology of leprosy is discussed in the light of the recent International Conference at Havana and particular attention is drawn to its report on Epidemiology & Control. The early contributions of Muir and Santra are acknowledged as pioneer work. It is stressed

that survey work unaccompanied by active control measures, or which does not add to the sum total of our knowledge of the epidemiology of the disease, is of little value.

The epidemiological work over the last ten years in Madras is outlined and certain salient features emphasised. The need for repeated surveys over a period of years in areas where no measures to control leprosy have been organised is stressed. For only thus will it be possible to study the conditions in a community which influence the control of the disease. It is believed that proper correlations of epidemiologic findings is the only sure way of developing a sound preventive policy. Too often measures which are taken to prevent leprosy ignore these facts and therefore much money is wasted and discouragement follows. The prevention of leprosy should be based on a careful study of all epidemiologic data which generally speaking are not difficult to secure.

9. Demonstration of Precrythrocytic Stages of a Malaria Parasite in the Himalayan Flying Squirrel, *Fetaurista* inornatus (Geoff).

H. N. Ray, Mukteswar.

From time to time since 1937 nine out of every ten specimens of Himalayan Flying squirrel were found to harbour a malaria parasite in their blood. Smears and sections of liver of the positive cases showed schizogony in (1) groups of small cysts besides (2) merocyst information as described for P. Kochi (=Hepatocystis Kochi) of monkeys by Garnham (1947). In two cases the spleen was involved while in one of these two the lumg also showed groups of small cysts. Microscopical preparations showing these various stages along with photomicrographs are presented for demonstration.

10. Intramuscular Paludrine.

R. N. Chaudhuri *and* N. K. Chakravarty,
Calcutta.

Paludrine lactate has been tried in thirteen patients suffering from malaria by intramuscular route in single doses varying from 100 to 300 mgm. The injections were somewhat painful but the pain and local tenderness usually disappeared within 3 days of the injections. On post mortem examination in a fatal case no sign of necrosis was noticed at the site of injection. Excepting one case of pernicious malaria with very heavy *falciparum* infection who died within 36 hours of admission, the temperature was normal and the peripheral blood was cleared of asexual parasites by the end of the third day of treatment in 66 per cent and 91 per cent respectively. In this series 3 *falciparum* cases relapsed after three weeks and one *vivax* case after six weeks.

11. Plasma Protein Changes in Tropical Eosinophilia.

R. N. Chaudhuri *and* H. Chakravarti, Calcutta.

The paper presents the results of a study of plasma proteins changes in a series of 37 patients suffering from *tropical eosinophilia* in the hospital attached to the School of Tropical Medicine. The diagnosis was based on the presence of pulmonary symptoms with an absolute eosinophil count in the peripheral blood of at least 2,000/cu. mm. The controls were selected for comparison from patients suffering from bronchial athma without eosinophilia. The average normal was determined among a series of 75 individuals representing the community comparable in status and dietary habits with the subjects of this investigation.

The plasma proteins were estimated by copper sulphate method and biuret method. The results of the analysis are given in the following table.

TABLE I.

		Total Protein	Albumin	Globulin	A/G
		Gramme per cent			X : 1
A. Tropical Eosinophilia (37 cases).	Range	9.6—6.5	4.6—3.0	5.8—2.0	0.6—1.2
	Mean	7.13	3.43	3.88	0.91
	S. D.±	0.73	0.48	0.65	0.19
B. Bronchial Asthma (8 cases).	Range	7.5—6.8	4.8—3.9	3.2—2.4	2.0—1.3
	Mean	7.0	4.3	2.7	1.6
	S. D.±	0.43	0.35	0.28	0.27
C. Normal (75 individuals.)	Range	8.0—6.2	5.5—3.9	3.3—2.0	2.4—1.5
	Mean	7.1	4-5	2.6	1.8
	S. D.±	0.73	0.37	0.29	0.23

The results indicate that, in general, there is frequent rise in globulin fraction which is occasionally so marked as to raise the total protein above normal. The albumin fraction appears normal or slightly depressed and the albumin globulin ratio is lowered due to the rise in globulin. In the uncomplicated cases of bronchial asthma hardly any change in plasma protein is noticed.

Estimation of plasma protein was repeated in 20 cases of tropical eosinophilia after the treatment with arsenical injections, the results being as follows as compared with the values obtained before the treatment was instituted.

TABLE II.

	Total Protein	Albumin	Globulin	A/G
	Gramme per cent			X : 1
Before Treatment	7.19±0.54	3.38±0.47	3.78±0.68	0.93±0.22
After Treatment	6.69±0.59	3.65±0.45	3.04±0.48	1.22±0.26

It is apparent from the above table that the plasma protein pattern tends to be normal after the arsenical treatment.

Conclusion —Hyperglobulinaemia with occasional rise in the total plasma proteins, the albumin fraction being normal or slightly reduced has been observed in patients suffering from tropical eosinophilia. This is very suggestive of a chronic infective process. These changes may also be helpful in the differential diagnosis of the doubtful cases of tropical eosinophilia from the uncomplicated cases of bronchial asthma.

12. Koilonychia (Spoon Nail) in Anaemia.

C. R. Das Gupta *and* J. B. Chatterjea Calcutta.

It is the condition in which the nail plate instead of being convex, is concave.

In mild cases the nail is simply flattened, but in the fully developed form it is concave in the centre and the edges are raised and project so much that the free margins and the sides are lifted off the nail bed. Some degree of longitudinal ridging may also be present. All the nails may be affected but the condition is most marked on the thumbs and fore fingers. It is generally found associated with hypo-chromic anaemia but has also been reported in cases of thyrotoxicosis and has also been seen in people working with sulphuric acid, Benzene, etc.

In a very large number of cases of anaemia, over 2,000 seen critically for over 10 years at the Anaemic Department of the School of Tropical Medicine, Calcutta, koilonychia has been noted so far in twelve cases only. In all these cases, the anaemia was hypochromic in type, and not a single case was seen in association with macrocytic anaemias. Of the twelve cases, eight were males and four females, one of which, a case of idiopathic hypochromic anaemia in an European female, aged 45 years, was reported in the I. M. G., April 1940. In the remaining eleven cases, the ages were 12, 15, 18, 30, 31, 36, 38 and 60 in the males and 17, 30 and 35 in the females. Five of the cases gave a history of piles for 2 years or more

and one female case gave a history of 13 pregnancies in 16 years. Fractional gastric analysis was done in five cases and free hydrochloric acid was present in all the cases and sternal puncture was done in six of the cases in all of whom the marrow was active and normoblastic in reaction. Mild H.W. infection was found to be present in 6 of the cases, many of whom gave history of bleeding piles as well, and it is presumed that anaemia in these cases was not due to infection with hookworm alone. On the other hand, we have never found koilonychia in any case of hookworm anaemia—due to heavy infection with hookworm. All the cases in our series improved with iron, but the condition generally persists even the blood picture returns to the normal.

Summary.—From critical observations in over 2,000 cases of anaemia, we are of opinion that though the presence of well defined koilonychia is a sure diagnostic feature of hypochromic anaemia, it is not a characteristic feature of hookworm anaemia, which is essentially hypochromic in type. The condition is, however, more commonly found in hypochromic anaemias due to chronic blood loss as in bleeding piles.

MICROBIOLOGY, PATHOLOGY AND PARASITOLOGY.

13. Inhibitive Action of Sodium Chloride Concentration on Non-pathogens in Foeces.

P. V. Gharpure, Bombay.

This is a continuation of the study on preservation of foeces for bacteriological study. The aim being the working out of an ideal concentration method for the Dysentery, Typhoid and Cholera group of organisms. By the use of the neutral glycerine saline (composition described by the author—I. M. G. Vol. IXXX, No. 12, p. 618-19, December 1945) and varying the NaCl concentration, colony counts are done. The optimum time and NaCl concentration are worked out.

14. Pyruvate Dismutation by Sensitive and Insenstitive Pathogens in relation to Penicillin Bacteriostasis.

Mariam George, P. A. Kurup *and* K. M. Pandalai, Bangalore.

In attempts made to elucidate the mode of action of antibiotic agents like Penicillin, we found that Magnesium ions have the interesting property of bringing down the minimum inhibitory concentration of penicillin in the case of gram-negative pathogens like *Esch. coli*. *B. dysenteriae*, etc. Since Magnesium ions play important roles as coenzyme in *in-vivo* phosphorylations it was thought that in the sensitive pathogens, phosphorylation reactions occur in a perfect manner while this is not so in the insensitive pathogens. Accordingly the dismutation of pyruvate by the sensitive organisms like *S. aureus* on the one hand and insensitive organisms like *Esch. coli* on the other was studied in the presence of added thiamine, magnesium ions, inorganic phophate, etc. The results showed that while added thiamine quickly disappeared in the case of *S. aureus*, there was no change in the case of *Esch. coli* When however magnesium ions were added, the added thiamine disappeared appreciably. By gas measurements and inhibition studies by the addition of small concentrations of agents like sodium fluoride, hydrogen cyanide, etc., to the cultures it was confirmed that reaction pathways could be altered in the case of *Esch. coli* and the organisms made to become more allied to the sensitive ones, thus requiring only lower minimum inhibitory concentrations of penicillin. It is therefore concluded from these studies that,

1. Sensitivity or otherwise of a particular pathogen to penicillin appears among other things to be tied up with metabolic reaction mechanisms adopted by the pathogens.

2. The magnesium ions appear to render insensitive organisms like *Esch. coli*, *B. dysenteriae*, etc., became more sensitive to penicillin by altering the reaction pathways in the stage where pyruvic acid is oxidised probably by rendering the phosphorylation of thiamine more efficient to produce cocarboxylase required for oxidation.

These results emphasise the possibility of rendering penicillin resistant organisms more sensitive to penicillin by appropriate treatment, an aspect of great theoretical and clinical importance.

15. Sensitisation of Penicillin Resistant Organisms by Mixed Culturing with Insensitive Organisms.

Mariam George *and* K. M. Pandalai, Bangalore.

We have shown that difference in the susceptibility of certain pathogens to Penicillin is associated with differences in the metabolic reaction pathways, adopted by the respective pathogens, as well as the presence or absence of certain catalytic complex systems in them. It should then be possible that pathogens short of or devoid of such catalytic mechanisms, if provided from without, could become more allied in nature to the Penicillin sensitive organisms and consequently become more susceptible to Penicillin.

That organisms do get sensitised according to this principle was revealed from experiments made by mixed culturing of a sensitive and insensitive pathogen, isolating them and studying their minimum inhibitory requirements of Penicillin. Thus untreated *E. coli* requires 10 units of Penicillin for complete inhibition while *E. coli* cultured together with a sensitive strain of *S. aureus* for 16 hours isolated and examined required only 1.0 unit per c.c. In a similar test *B. typhosum*, requiring 12 units per c.c. in the untreated state, required only 4 units per c.c. Indeed the minimum inhibitory concentration of Penicillin in the case of *S. aureus* itself came down to 0.03 unit per c.c. from 0.1 unit per c.c. when it was grown in association with *E. coli*, and to 0.04 unit when grown in association with *B. typhosum*. An association of half an hour at 37°C is enough to effect a transference of sensitivity. The aquired sensitivity lasts for fairly long intervals. It was however observed that when *B. dysenteriae* was grown in association with *S. aureas*, the former became more resistant to penicillin.

This shows that while there are a number of yet unknown factors in reversing drug resistance, the sensitivity of pathogen to a drug like penicillin is a very labile factor of the bacterial cell, which is essentially a chemical one. Organisms do adjust themselves in their metabolic reactions by adapative changes, when grown in association, such that it is possible to render insensitive pathogens more sensitive to a drug as a result of the functioning of unknown symbiotic agencies. The wide possibility of these findings in reversing drug resistance in resistant pathogens and their clinical application are discussed.

16. Study of a Quantitative Test for Urobilinogen in Urine.

P. V. Gharpure, Bombay.

Detection of urobilinogen was recommended for the diagnosis of malaria. The method recommended has been studied in detail and a simplified technique is described. The temperature, time factor, quantity of the urine and the reagents, effects of the size of tubes, the diameter and height are some of the factors studied.

The method described by the author is efficient and less expensive.

17. Diagnosis of Human Plague by Sero-agglutination Test.

G. Panja *and* S. K. Gupta, Calcutta.

During the last epidemic of plague in Calcutta, which started in April 1948, 169 cases were bacteriologically investigated. 17 cases were bacteriologically positive for plague bacilli and in 15 cases, slide agglutination test of the patients' sera with four live strains of *Past, pestis* was satisfactorily positive. Tube agglutination test was also positive but was not so satisfactory for recording as the former. In 2 cases only the test was negative and the serum was collected very early in these cases, i.e., on the 3rd or 4th day of disease and one patient died on the 3rd day of disease. In the positive cases, agglutinin was detectable generally on the 7th day of disease, earliest being the 4th day and it persisted uptill 1 month (examined).

Eleven suspected cases were bacteriologically negative both by bubo puncture and by blood culture and in all these cases agglutination test was positive in the majority of cases from the 4th to 6th day of disease. Without the help of the agglutination test, it was not possible to diagnose these cases bacteriologically. These were simply suspected cases.

In the rest of the suspected cases, cultural as well as the serological tests were both negative.

In all the bacteriologically and serologically positive cases, agglutination test with *Past. pseudotuberculosis* and *Past septica* was negative. Sera from 75 normal cases examined did not show any agglutinin for *Past. pestis*. All our 4 antigens for agglutination test were agglutinable with specific plague immune rabbit sera (American).

18. Studies on the Oxygen Requirements of Nematodes.

P. V. Gharpure, Bombay.

Two nematodes are studied—

(1) Ascaris lumbricoides (of man).

(2) Strongyloides (of dog).

These can survive outside the host for varying periods, the former less and the latter longer.

By excluding oxygen the viability has been studied.

Suggestion is put forth that intestinal parasites are partial anaerobes.

19. Acute Dysentric Conditions due to Schistosome Infection in Cattle.

S. R. Rao, Bombay.

Schistosomes as a cause of dysentry in cattle was for the first time noted in this country. The organism that was responsible for this condition is identified as *Schistosoma-bovis* whose occurance in India gave rise to much controvercy. The author pleades for a thorough investigation of this problem throughout the Indian Dominion so that suitable treatment could be given in time. It is felt this condition whether due to *Schistosoma-bovis* or any other sp. is more widespread than is believed to be. Photographs of the eggs of *Schistosoma-bovis* together with those of S. indicum and S. haematobium are given for comparison.

ANTIBIOTICS

20. The Antibiotic Principle from the Roots of Aristolochia Indica.

P. A. Kurup, Mariam George *and* K. M. Pandalai, Bangalore.

During the course of a detailed search of the more important Indian medicinal plants for their antibiotic contents, it was found out that the roots of *Aristolochia Indica* gave an alcoholic extract which was highly antibacterial to test organisms like *Staph. aureus* and *E. coli*. An attempt was then made to concentrate the active principle and to determine its antibacterial spectrum.

500 grams of the fresh roots of the plant were chopped into small pieces and extracted overnight with absolute alcohol (4 c.c. per gram). The extract was concentrated and diluted with three volumes of water. It was then acidified with 2% Hydrochloric acid and was extracted with ether. The aqueous portion was separated and neutralised with Sodium bicarbonate and again extracted with ether. The ether extract was washed with water until free from alkali, and the ether removed at low temperature in vacuum. 65 m. gms. of the crude product was obtained as a pale yellow solid. It inhibits the growth of *Staph-aureus*, *E. coli* and *E. Typhosa* at a dilution of 1/50,000, while that of *B. dysenteriae*, *Para-B*, and *Para-C* at a dilution of 1/100,000. Attempts to purify the product further and to study its toxicity, blood level etc. are in progress.

21. Search for Antibacterials *in Phanarogams*.

G. C. Mitra, K. R. Chandran *and* N. K. S. Rao, Calcutta.

The accordance of antibacterial principles with certain higher plants remains an established fact and several such substances antagonistic to bacteria, diverse in nature have

already been isolated. In this paper a systematic investigation—for a search for antibacterials in species of phanerogams selected mainly on the basis of Ayurvedic Materia Medica has been carried out and the results of plants so far studied have been noted, especially detailed investigations are being continued in the case of promising ones.

Fresh plant materials, locally collected were washed and macerated with purified sand into a pulp with just the requisite quantity of distilled water, strained through muslin and finally filtered free of chlorophyll. The pH of these extracts were adjusted to 7.4—7.6.

The plant extracts were tested by our modified double plate method against nine pathogenic species of bacteria both gram+ve and gram−ve types including *Bacillus subtilis* (viz., *Staphylococcus aureus, S. albus* Woods, *Escherichia coli communis, Salmonella schottmulleri, Eberthella typhosa, Shigela dysenteriae var. Shiga, Vibrio cholerae* Inaba and *Klebsiella pneumoniae*). Fifty-five plants belonging to 31 families have so far been studied and it is being noted that *Paasiflora foetida* Linn., *Clematis cadmia* Ham., *C. gouriana* Roxb., *Glycosmis pentaphylla* Corr., *Cinnamomum zeylanicum* Bryn., *Calotropis procera* Br., *Tagates patula* Linn., *Lippia nodiflora* Rich., *Euphorbia pilulifera* Linn., *Hiptage madablota* Gaertn., and *Croton sparsiflora* Morong. have all shown complete inhibition of all or most of the above mentioned bacteria and the rest have shown either partial or no inhibition of them.

22. Antibiotic Activity as shown by a Highly Amylolytic Strain of Bacillus Subtilis.

Bhagwan S. Lulla, Bangalore.

Bacillus subtilis when grown on wheat bran produces antibiotic activity which is maximum in 24 hours old culture, correspondingly the amylase activity during this period is very low. When the incubation period is further extended, the antibiotic activity steadily decreases and the amylase activity at the same time increases.

B. subtilis is non-lipolytic in its action, when it is grown on wheat bran as a whole and defatted wheat bran respectively the concentration of amylase and antibiotic secretions in both cases remain nearly the same. This suggests that the antibiotic activity is not due to the hydrolytic products of wheat bran fat as stated by earlier workers.

The relationship between the amylase and antibiotic production by the genious *B. subtilis* when grown on wheat bran has been discussed.

PHARMACOLOGY AND THERAPEUTICS.

23. Studies on the Toxicity of certain Formo-Sulpha Compounds.

A. N. Bose, Calcutta.

Sulphonamide derivatives are not so effective in the treatment of Asiatic Cholera. Some reports are available regarding the beneficial effects of sulpha-guanidine in such cases Recently, Bhatnagar *et al* have recorded successful results on the treatment of Asiatic Cholera cases by a formaldehyde derivative of sulphathiazole, termed 6257 (Nature, **161**, 395, 1948). In order to study the characteristic of other similar compounds, formol-derivatives of sulphacetamide and sulphanilyl benzamide have been prepared in this laboratory and subjected

to pharmacological studies. It is being found that sulphacetamideforma compound is more toxic than the corresponding Sulphanilyl Benzamide compound, though it does not affect the rate of normal growth of mice. The drug was fed 1 mg./gm. orally for 10 days as well as by drug-diet (2%) for 15 days). P-methylol-amino-sulphanilyl benzamide given with drug diet (2% for 15 days is found to be devoid of any chronic toxicity, as shown by the normal growth curve of mice, and absence of any mortality, when observed for a period of 5 weeks.

24. Studies on Arsenoxide Derivatives—Part I.

A. N. Bose, Calcutta.

p-carbamidophenylarsonic acid (Carbarsone) is a well-tolerated amoebicidal with wide use. Though effective, it has not served as yet a permanent curative effect in cases of cronic amoebic dysentry Accordingly the co-rresponding arsenious derivative has been prepared in this laboratory and subjected to pharmacological tests. It is being found that p-carbamido phenyl arsenious acid. (CP.A.) possess more toxic properties than carbarsone. Orally fed in 4 mg. per gm. dose to mice for 7 days, it causes 60% mortality in 4 weeks. In drug-diet also of (0.5 to 1%) it causes great retardation of growth and late mortality. Carbarsone in 2% drug diet causes neither any mortality nor any effect on the rate of normal growth of immature mice, when compared with control animals. Post mortem findings of mice died from C.P.A. reveals fatty infiltration of liver, enlargement of kindneys, and congestion of spleen.

25. Studies on Sulphonamides and Analogous Compounds : Part IV—Role of Unsaturation on the Antibacterial Activity.

N. K. S. Rao, K. R. Chandran *and* U. P. Basu, Calcutta.

The activity of the Schiff's bases prepared from Sulfathiazole, p-amino phenyl methyl sulphone, 5-amino salicylic acid and p-amino benzoic acid by reacting with cinnamic aldehyde against *E. typhosa* and *V. Cholerae* indicates that the unsaturation in a compound may play a role in imparting and/or enhancing the bactericidal property in a compound which may itself be an inhibitor, or promoter for the growth of the organism in culture medium. As these cinnamic aldehyde derivatives are not completely hydrolysed by 0.4 % hydrochloric acid within a period of 3—4 hours and as some of these compounds are very active against *E. typhosa*, their further study would be of considerable significance.

26. A Preliminary Note on the Action of *Pterocarpus Marsupium* on Blood Sugar.

K. N. Ojha, Paramjit R. Pabrai *and* K. Venkatachalam, Cuttack.

Pterocarpus Marsupium Roxb. (N. O. Leguminosae) has been known to possess anti-diabetic properties ; drinking water from vessels made of the wood has been reported to be used by diabetic patients.

A study has been made on the action of the drug on blood sugar to ascertain if it has got any antidiabetic effect.

A 1 in 10 aqueous extract was used. After taking the blood fasting of rabbits and diabetics, one ounce of the above extract was administered orally. Blood was taken every hour for five hours and blood sugar was determined of each specimen and of the five-hour pooled sample. A continuous fall in blood sugar was observed, the maximum percentage blood sugar reduction being in the second hour after administration of the drug in rabbits as well as in diabetics.

Urine examination of the same diabetics with Benedict's Reagent showed continuous and rapid disappearance of sugar in hourly specimens. Last sample showed absence of sugar.

No toxic symptoms were observed. No alteration in the concentration of glucose was observed in *vitro* tests.

As the drug has been tried only in a few cases no final conclusions can be drawn in respect of the mode of action, the optimum initial and repeater dosages and identification of the antidiabetic principle. Work in these directions is in progress.

27. On the Efficacy of Tobacco Leaf in the Treatment of Sarcoptic Mange.

Paramjit R. Pabrai, P. S. Kupuswamy, K. Venkatachalam *and* K. N. Ojha—Cuttack.

Sarcoptic mange was observed in rabbits kept for experimental purposes in the Department of Pharmacology and Pathology here. Usual advice given in such cases is to destroy the individual rabbit to stop the spreading of the infection. Tobacco is said to possess antiseptic properties when used locally. With the idea that it may be effective a chance was taken with an alcoholic extract (1 in 10) to treat this condition.

Sarcoptic mange was diagnosed microscopically in the suffering rabbits, the lesions were painted with the medicament twice a week. Remarkable progress was observed on the very first application. There was a gradual falling down of the crust from all the lesions, leaving healthier skin underneath. Almost simultaneously with the falling of the crust hair growth made itself manifest. On an average four to five applications were sufficient for complete recovery. All cases without exception proved amenable to this treatment. Local applications do not produce any toxic symptoms except mild irritation for a short while.

The drug may also be of grrat therapeutic value in the treatment of alopecic conditions due to parasitic infections.

28. On the Efficacy of Sex Hormones in the Treatment of Peptic Ulcers

K. N. Ojha *and* K. Venkatachalam, Cuttack.

Since 75 to 80% of the cases of peptic ulcers occur in men and their complications are observed 10 to 15 times more in men than in women, it was thought worthwhile to try the effects of female sex hormones on the symptoms of a few cases of gastric and duodenal ulcers in men. The results being encouraging, they are submitted with the idea that others may subject this line of treatment to more trials and if their observations are so encouraging as they have been with us and warrant the use of the hormones in the treatment of these ulcerated conditions of stomach, a great boon will be conferred on the suffering humanity.

In our experiments, stilboesterol was used in 10 mgm. doses daily for 8 to 10 days or till the patient complained of tender and enlarged nipples. A few days after stopping the treatment the symptoms get less and gradually disappear. In some cases abatement of symptoms occured from the second day of the beginning of the treatment. The symptoms generally disappear in about 2 to 4 weeks time.

Since cases treated have been few in number and have not been under observation for long it is not possible at this stage to assert as to when the symptoms will reappear, if at all, and would necessitate repetition of the treatment.

29. Studies on the Chemotherapy of Vibrio Cholerae.

N. K. S. Rao *and* U. P. Basu, Calcutta.

The findings of Poth & Ross (*J. Lab. Clin. Med.* **29**, 785, 1944) on the activity of pthalyl Sulphathiazole in bacillary dysentery, and of Bhatnagar *et al* (*Nature*, **161**, 395, 1948) on the chemotherapeutic value of "6257"—a condensation product of sulphathiazole and formalin, tend to show that for the manifestation of effective therapeutic activity the Sulpha-compound must be ingested in such a way that it may be present at the focus of infection in its active anion form with free amino grouping for engaging the acid group of the bacterial enzyme protein (*cf.* Klotz J. M., *Science*, **98**, 60, 1943 ; Davis & Wood, *Proc. Soc. Expt. Biol.* Med., **51**, 283, 1942). With a view to explore the possibilities of encountering more potent derivatives, various well-known Sulphonamides have been reacted with formalin and the resulting 4-hydroxymethyl-amino-benzene-Sulphonamide derivatives have been studied *in vitro* for their activity against *V. cholerae*. The speciality of the compound derived from Sulphanilyl-benzamide has been discussed.

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SECTION OF AGRICULTURE

PRESIDENT : DR. R. S. VASUDEVA, Ph.D., D.Sc., D.I.C.

Abstracts

1. Control of Agrotis Pest by Cultural Operations.

A. C. SEN, Sabour, Bihar.

Agrotis ypsilon Rott. in its caterpillar stage has been responsible for causing destruction to about 20 to 47% of the total Rabi crops produced in Bihar. Our laboratory trials had shown that the caterpillars attack the gram and wheat seedlings from the shooting up of the sprouts to 22 days' old plants and plants of 3 weeks' standing can considerably resist the attack and do not suffer much.

It has been found that the maximum damage is caused by the second brood of the pest and this happens in the first fortnight of November. The only inexpensive devise to tide over this critical period of attack is to resort to the inexpensive cultural methods of control, that is, either by advancing the sowing time or by delaying it, so as to get a clear margin of 3 weeks' time.

In 1947, large scale field trials were laid out at the common habitat of this place, in the low lying areas in Bhagalpur district, at the two adjoining villages Dhanaura and Amdhar, with a view to find out the effects of early and of late sowing on the incidence of the pest under natural conditions. The areas were thoroughly surveyed before sowing oporations, had identical conditions and plot history and had been kept under regular observations till harvest. 4 such plots of land, of ½ acre area under each and at a distance of 600 to 800 yards away from one another, were selected for the purpose. In the first village, sowing was done on 18th, 22nd. and 26th. October, 1947 and in the other series, in village Amdhar, on 12th, 16th and 20th November, 1947. Sowing was done in the control plots, at both localities, on 4th November, 1947 which was the usual date of sowing in these localities.

Results—In the early sowing plots, the incidence of attack in all the plots were nil and in the Control plot it was 15% and a loss of 30% of the crop yield. In the late sowing series, the incidence of pest attacks was more marked in the plots wherein sowing was done in the first part of November that is, from 4th to 12th November, 1947 resulting in 20% infestations on the control plots and a loss in yield by 47% and thereafter gradually declining with late sowing of the crop, that is, an infestation of 8% on the plot where sowing was done on 12.11.47 and nil on the other plots where sowing was done on 16th and 20th November, 1947.

2. Albinism in Sugarcane.

GYANENDRA VARMA, Shahjahanpur.

A certain number (1% to 2%) of albino plants and tillers appear in Sugarcane fields in July and August, which die out by the end of monsoon. These plants are usually regarded as genetic sports, arising from bud mutation. Data are presented to show that certain cultural treatments, *viz.* delay in planting, irrigation after sowing,

applications of nitrogenous and phosphatic manures affect the incidence of albino plants in a given plant population, whereas the time of application of manures, and the application of K_2O have no effect on their occurrence. There are slight indications that applications of Mg, Mn and Cu are beneficial in this respect. Whereas the above observations suggest that albinism is not a purely genetic phenomenon, its being partly so is not altogether ruled out.

3. Seed Treatment of Rice.

K. RAMIAH *and* S. Y. PADMANABHAN, Cuttack.

An experiment was conducted to test the effect of seed protectants on the germination of rice and to test how long treated seeds of rice would retain their viability unimpaired in storage. Ten varieties of paddy were treated with 4 protectants, namely Agrosan G.N., Arsan, Phygon, and Spergon, and at 3 levels of concentration, namely, 1/250, 1/500 and 1/750 of the weight of protectant to the weight of grains. Two series of controls were maintained : One in which the seeds were treated with the diluent used in the chemicals *viz.* talc, and the second without any treatment whatsoever. The seeds were treated in the last week of January and stored in cloth bags. Eight germination records were taken at 30 day intervals from February '48 until Sept., '48.

The results show that the germination is not adversely affected by long storage after the treatment. While the fall in viability of the grain was very rapid in the controls after the 6th month and beyond, such fall was not noticeable in many of the treatments, notably in the Phygon and Spergon series ; the loss of viability was low or negligible. By the time the viability was completely lost in most varieties by the eight month, the treated seeds gave germination of 65 to 85%.

It is known that several of the early rice varieties lose their viability in storage after a few months, particularly when the storage period happens to synchronise with rainy weather conditions. Where such storage is inevitable the use of the chemical protectants appears to be encouraging. The investigation is being continued.

4. A New Method of Cane Plantation in the Water-Logged Area of the Rajshahi District during Monsoon.

T. C. N. SINGH, Annamalainagar.

It has been established that early plantation of canes during August-September-October, ensures better performance than the November-December plantation. But uncertain conditions of monsoon have been a limiting factor. The plantation is, therefore, resorted to by seedlings raised in nursery beds. This naturally has been a very tedious method involving a very high cost of cultivation.

Under the new scheme the sets are directly planted parietally on one side of the trench and they are left bare un-covered with earth ; the final operation of covering them with earth is deferred to a stage till the germination is complete.

In the case of Co 421 and Co 527 acclimatised under the ecological conditions of East Bengal, it has been found that if the planted sets remain submerged under water for even more than two weeks, the viability of the buds is not impaired at all, rather they keep growing even under these abnormal conditions and after the recession of water, the germination completes up very quickly. In each case under observation, it was found that the germination percentage was not less than 92%. Soon after that as soon as the dry conditions intervene, the sets are covered. The subsequent growth and performance have been found to be very satisfactory, both from the view point of tonnage and sucrose content.

5. On the So-called "Deterioration" in Sugarcane Varieties.

N. L. DUTT *and* K. S. SUBBA RAO, Coimbatore.

Complaints are occasionally received from cane growers as also from certain farms that the sugarcane varieties in their respective tracts are showing deterioration.

The sugarcane variety Co. 419 which has given such good results both in the cultivators' fields and the factory farms in the Bombay Presidency was reported to have "deteriorated." This so-called "deteriorated" material of Co. 419 was obtained from the Bombay Presidency and was grown along with the healthy material maintained at the Coimbatore Station. The plots were laid out in the A B B A pattern and replicated four times. The data were analysed statistically and the differences regarding (1) weight of canes per row, (2) brix, (3) sucrose and (4) purity, were not found to be significant.

The above result is what might have been expected because, strictly speaking, deterioration cannot occur in Sugarcane varieties as the vegetative propagation is merely multiplication of the same individual without any change in the genetical make up.

Yield data of certain well known commercial canes maintained at the Java and at the Coimbatore Stations for over a decade are also presented and it is shown that their yields have not diminished.

The following four factors have, however, their own influence but there is no indication that the varieties, as such deteriorate. These factors are (1) envioronmental conditions, (2) bud variations, (3) reduction in soil fertility and (4) selective influence of diseases and pests and the part played by them is discussed in the paper.

No cane cultivator need fear that his popular variety is "sunning out" All that is necessary for maintaining steady yields is to see that the crop is kept free from pests and diseases and is planted in a soil, the fertility of which is maintained by suitable manuring.

6. A Preliminary Study of the Effect of Trace Elements on the Growth and Bud-Boll Formation in Vijay Cotton.

H. M. PATEL *and* D. K. PATEL, Baroda.

Preliminary pot experiments carried out to study the effect of Boron, Magnesium, Manganese and Zinc on the growth and bud-boll formation of Vijay cotton at two levels along with manurial NPK pot experiments, show that Manganese and Zinc give significant effect on the growth and bud-boll formation. Seed treatment experiments are in progress.

7. Diaeretus Aphidae, sp. nov. Parasitic on *Pterochlorus persicae* Chpldk, affecting Prunus Persica (Peach) in Baluchistan.

S. MUKERJI *and* S. N. CHATTERJEE, New Delhi.

The genus *Diaeretus* belongs to the family Aphidiidae the members of which are known to parasitise different species of aphids. The genus *Diaeretus* is one of the less studied ones among the genera of Aphidiidae. The parasite described in this paper was reared from the aphids—*Pterochlorus persicae* Chpldk, affecting peach as also from another type of Aphis affecting cabbages in Baluchistan. The species described is the first record of the genus from India, the only other sdecies *D. oregmae* Gahan described from the oriental region was collected from the Philippines.

The Indian species differs from *D. oregmae* Gahan in the number of joints in the antennae, length and thickness of pedicel as compared to the scape, number of joints in the maxillary palpi, shade and hairlessness of eyes ; position of the ocelli ; the strong, well developed tibial spur of the fore leg ; shape of stigma, size of radius and metacarpus in the fore-wings.

Figures of the head, thorax fore-wing, and female and male genitalia of the species given and descriptions are embodied in the paper to help in the correct identification of the species.

8. Relation between Some Analytical Constants of Ghee.

K. M. MEHTA, Jodhpur.

The chemical constants namely R.M., P.V., S.V. and I.V. have been determined in goat and sheep ghee and inferences drawn from their relationship. There is a wider

limit between the constants of goat ghee than sheep ghee. In both there is a direct relationship between R.M. and P.V. though not as regularly as found in ghee of cow and buffalo. The saponification values in both cases vary in close limits and approach those obtained by workers in western countries. There is a direct relationship between I.V. and R.M. in goat ghee while this relation is inverse in the case of sheep ghee. In both cases

$$\frac{\text{S.V.}}{\text{R.M.}+\text{P.V.}+\text{I.V.}}$$

is a constant figure. This relationship can be beneficially utilised in detecting sophistication where goat and sheep ghee is mixed with cow and buffalo ghee.

9. Frequency of Cold Waves in India.

OOMMEN CHACKO, Poona.

Frequency of cold spells during the winters from December 1943 to February 1948 when the minimum temperature in the Stevenson Screen fell below 40°F is discussed in this paper. Frosty conditions are likely to exist in the open field when the minimum temperature in the Stevenson Screen falls below 40°F. It is shown that there is a variation in the intensity of cold waves as well as in the extent of the area affected during the various years. Winters during the period from December 1946 to February 1948 were comparatively milder.

10. The Study of Current Weather Week by Week during the Year in Relation to Crop Out-look and Phenology.

L. A. RAMDAS, A. K. MALLIK, T. S. GOVINDASWAMY
P. V. PIMPALWADKAR, Poona.

The paper describes a striking method of representing diagrammatically the seasonal march of, as well as the marked abnormalities, in the major climatic factors in the various sub-divisions of India.

The purpose is to show how in any particular year, the march of the weather during the year is associated with the sequency of phenological events like (a) germination—tillering-growth—flowering—fruiting—harvest in the case of crops and (b) leafing, leaf-fall, flowering, fruiting, fruitfall, etc., in the case of trees. Each diagram relates to a particular meteorological element and shows at a glance how this element has varied week by week in the various sub-divisions of India *i.e.*, in the country as a whole. Such diagrams have been prepared for rainfall, maximum temperature, minimum temperature and relative humidity and will be shown at the meeting.

11. Entomological Investigations on the Leaf-Curl Disease of Tobacco in Northern India. VIII. Correlation between the Heights of Diseased Tobacco Plants and the Types of Leaf-Curl Virus causing Infection in the Field.

C. K. SAMUEL, New Delhi.

In the course of entomological investigations carried out at pusa (Bihar) on the tobacco leaf-curl virus during 1936-41 (Pruthi and Samuel, 1939, 1941), different diseased tobacco plants in the field were frequently observed to have a characteristic

range of heights between certain limits. This phenomenon led to the assumption that a certain correlation could possibly exist between different types of leaf-curl and their corresponding heights. In order, therefore to make a detailed study of this correlation, if any, two varieties of cigarette tobacco, *i.e.* Harrison Special and I.P. Hybrid 142 were selected for comparison and the heights of a large number of healthy and leaf-curl infected plants in the fields of the Botanical Sub-station, Pusa, showing almost single types and their mixtures were carefully measured and recorded. The corresponding number of leaves present on those plants was also recorded.

Examination of the data thus collected showed that healthy plants were ordinarily the tallest in both the varieties. Among the four chief disease-types (A to D), A's average height in H-142 was less than half of its own height in H. Special. B's average height was even less than A in the latter variety, but almost same in the former. C was the tallest among all the types, and D was the next. AX was distinctly taller than either A or B. Among the mixtures AB, AC, and AD, AC was the tallest followed by AD and AB in both the varieties. The influence of C to increase the plant growth either alone or combined with other types (like B or D) was characteristic. In a mixture of A, C and D, the influence of C was mitigated to some extent by the presence of A although D also had a character similar to C to increase the height of the plant. Although the heights of the diseased plants were dependent on the types of leaf-curl affecting them, the total number of leaves present was not entirely dependent on the plant heights.

The data have been fully discussed.

12 Analysis of Agricultural Yields. II. Effect of Cultural Treatments on the Incidence of Gram Wilt (*F. Ortho-Ceras* Var. *Ciceri.*)

P. C. RAHEJA *and* G. P. DAS, New Delhi.

Suitable adoption of cultural methods as a means to check the wilt incidence of gram has been investigated in a multiple-factor experiement comprising three days of sowing, three spacings and two depths of seeding. The data recorded on stand of the crop, its growth in height, flower production and yield per acre were interrelated to wilt incidence. The results derived were as under :—

1. Early wilt occuring within the first fortnight after germination was of low intensity than late wilt appearing in march.

2. Initially well grown plants were found to be more susceptible to wilt incidence. Non-wilted plants tended to make up in growth by a significantly higher rate of relative growth compared to the wilted ones.

3. Incidence of wilt made no difference either in the rate or total flower production of plants.

4. The incidence of wilt corresponds to the trends of the grain yield relating to the treatments of the dates of sowing and depth of seeding. Interspacing of rows made little difference in this respect.

13. Spray Programme for Controlling Anthracnose and Mildews of Grape Vine in Hyderabad State.

SYED VAHEEDUDDIN, Hyderabad-Dn.

Several spraying and dusting experiments for the control of Anthracnose (Glaeosporium ampelophagum), Downy mildew (Plasmopara viticola) and Powdery mildew (Uncinula necator) were carried out in Aurangabad district for a period of 3 years. One row of 9 vines of the variety Bhokri was taken for each replication. The treatments were randomized and replicated 4 times. One row of vines was left untreated between every two treatments as buffer. Fair development of Anthracnose and Powdery mildew and little of Downy mildew on almost all the untreated vines was noticed, whereas the treated vines showed only traces of these diseases. Spraying with Bordeaux mixture and dusting with Sulphur gave the best results. Time and details of spraying and dusting have been indicated in the paper.

14. Influence of Ionic Diffusion in the Extraction of Soil Solutions by the Displacement Method.

C. DAKSHINAMURTI, New Delhi.

The influence of diffusion on the displacement of electrolytes through capillary tubes has been studied. From geometrical considerations the diffusion is shown to be more effective at lower velocities of flow which correspond to the movement of soil water. This provides a theoretical basis for the displacement methods often used for the extraction of soil solutions.

15. Soils of Rann of Cutch and Possibilities of Reclamation.

J. N. MUKHERJEE *and* K. V. S. SATYANARAYANA, New Delhi.

In a very rapid reconnaissance survey the soils of Rann of Cutch have been examined on profile basis. The soils have been further examined in the laboratory for their mechanical constituents, salt content and nature of salt. The surface soils are silty clay in texture, which generally becomes lighter with depth. The pH of the soils is round about 8.0. The soluble salt content of the soils is high and apart from gypsum the salts consist mainly of sodium chloride, carbonates are practically absent and bicarbonate is uniformly low. The presence of gypsum in the soil and the availability of a large volume of water for washing out the salts indicate that at least considerable area can be reclaimed.

16. Study of Saline and Alkaline Soils of Rann of Cutch in relation to their Reclamation.

K. V. S. SATYANARAYANA *and* C. L. KUMAR, New Delhi.

The soil samples relating to a saline and alkaline profile (Lakhpat-Piprala Profile) collected during a rapid reconnaissance survey of Rann of Cutch were leached with water and the changes in soil reaction were followed. It was found that successive leaching shifted the pH to the alkaline side and further leaching brought down the pH. It was noticed that the rate of leaching shows down in some samples. By successive washing out the soil in water suspension occupies a larger volume and finally some soils showed a dispersion. The dynamics of reclaiming this type of soils are considered.

17. Some Observations on the Interspecific Cross Luffa acutangula Roxb. X L. cylindrica (Lour.) Roem. (=*L. aegyptiaca* Mill).

H. B. SINGH *and* B. P. PAL, New Delhi.

The F_1 hybrids raised by hybridization between *L. acutangula* Roxb. (both monoecious and hermaphrodite varieties) with monoecious *L. cylindrica* (Lour.) Roem.=*L. aegyptiaca* Mill were studied and the results reported. In the different crosses the progenies consisted of plants which were, either of the 'normal' or the 'abnormal' type. The 'normal' type resembled the parent varieties in general habit of growth, flowering and fruiting but fruits were bitter. The 'abnormal' type was characterized by compact habit, dark green puckered and irregular leaves, short internodes and abnormal racemes, the fruits being however free from bitterness like the parents. Both the types were 70-80% pollen sterile. The fruits were formed but the percentage of viable seeds was very low (5-10%). The hybrids of crosses with hermaphrodite varieties of *L. acutangula* produced purely monoecious type of flowers in the beginning but

later were followed by the production of female flowers on the male receme and finally it was observed that hermaphrodite flowers also were produced in large numbers. These three types of flowers were localized in different positions in the inflorescence and such positions varied also. The 'normal' type hybrids (with hermaphrodite varieties) showed 57.5% increase in yield over the better parent (*L. acutangula*) and the 'abnormal' type showed a decrease of 28.8%. The increased yield is however not economically important as such plants invariably produced bitter fruits. The characters of *L. cylindrica* were generally partially dominant in the F_1. The 'normal' type F_1 produced normal plants in the F_2 whereas the 'abnormal' type produced both the types. The progenies were not economically promising.

The results of this hybridization study indicate that it may not be possible to select any new promising strains superior to the parent varieties, from this cross.

18. Indicator Plant Studies. I. Experiments with *Berseem* (*Trifolium Alexandrium*).

W. V. B. Sundara Rao *and* A. B. Ghosh, New Delhi.

The purpose of these investigations is to select suitable plants to indicate P_2O_5 deficiencies in the soil either by visual deficiency symptoms or by response in yields to the additions of P_2O_5.

Reddening of berseem plants has been ascribed as a deficiency symptom exhibited by the plants due to nutritional disorders. In the first year 1946-47, pot culture studies were conducted with a soil having 0.027% available P_2O_5 and not much of reddening was observed. Maximum growth was observed with pots receiving 150–200 lbs. P_2O_5 per acre showing thereby that the available P_2O_5 was not enough and a further application of 150 lbs. P_2O_5 per acre to the soil was necessary to meet the demand of this legume for vigorous growth, though the P_2O_5 content of the soil was not so low as to introduce deficiency symptoms in berseem.

In 1947-48 two soils were taken, (1) with an available P_2O_5 content of 0.003% and the other with a content of 0.023%. P_2O_5 was added in various doses from 0 to 250 lbs. at 50 lbs. intervals, with or without basal dressings of $N_{20}K_{50}$ and $N_{60}K_{150}$ per acre respectively. With soil (1) low in available P_2O_5, 40% plants showed reddening symptoms in cntrol, which decreased to 2.5% and nil with 200 and 250 lbs. P_2O_5 per acre. With $N_{60}K_{150}$ basal dressing a decrease to 9% was observed even with 150 lbs. of P_2O_5, the figure being 1% with P_{200}. Basal dressing of either $N_{20}K_{50}$ or $N_{60}K_{150}$ alone did not reduce appreciably the percentage of plants showing reddening symptoms (41% and 34%). With soil (2) richer in available P_2O_5 the percentage of plants showing those symptoms was only 14 for the control. P_2O_5 at 150 lbs. per acre alone reduced it to 10% which along with a $N_{60}K_{150}$ dressing further went down to 4%.

After the first cutting the symptom practically disappeared and the number of red plants did not exceed 2% in any of the treatments.

However, in a field experiment reddening symptoms in berseem were found to be associated with extreme deficiency of N. Thus the reddening symptoms as discussed in a separate paper by Rao and Tejwani may be either due to extreme deficiency of N or P.

In the soil with low available P_2O_5 content, significantly increased yields (90% over no manure) were obtained with P_{100} and maximum yield (100% over no manure) with P_{250} among all the doses tried. The basal dressing $N_{60}K_{150}$ was superior to $N_{20}K_{50}$ and to control. P_2O_5 singly gave better yields than N and K treatments. NPK and NP proved better than P alone. Potash effect was not significant as judged by compairing the yields due to NP and NPK treatments. With the second soil riche in available P_2O_5 26% and 33% increases in yields were obtained with 150 and 200 lbs. P_2O_5 per acre. The effects of the basal dressing of $N_{60}K_{150}$ was to raise the yield at each dose of P_2O_5 compared to the corresponding doses at $N_{20}K_{50}$ and N_0K_0 levels in both the soils.

The control in the second series gave more yield than even an application of 250 lbs. P_2O_5 in the soil having low P_2O_5 content, showing thereby that more yields might be obtained in soil 1 by further i rease in the doses of fertilizers.

19. Indicator Plant Studies. II. Experiments with Maize (*Zea mays*).

W. V. B. Sundara Rao *and* A. B. Ghosh, New Delhi.

Maize plants grown in greenhouses have been observed to indicate N-deficiency by its pale green foliage, stunted growth and the older leaves drying up rapidly from the tips (firing). The plants also indicated P-deficiency by its dark green foliage, lack of growth and violet streaks appearing occasionally on the leaves.

Studies were conducted with two Delhi soils, the first one having low and the other high available P_2O_5 (0.003% and 0.023%). Apart from the visible deficiency symptoms, the plants showed very distinct responses in yields due to N and P. With the former soil low in available P_2O_5 NPK (at 100 lbs. per acre doses of each) gave $3\frac{1}{2}$ times more yields than that of no manure, N alone giving $1\frac{1}{2}$ times, NK giving twice. The yield due to P alone was 30% higher than that receiving no manure. The corresponding figures with the latter soil richer in available P_2O_5 were 3 times, $1\frac{1}{4}$ times, twice and 20% more than that of no manure. All the yields were better than the corresponding ones in the first soil indicating the higher fertility status of the second one.

Thus it was observed that a plant like maize, having high N-requirement for its growth, very easily indicated its deficiency both by visible symptoms and more by the response in yields.

Apart from the above observations, the available P_2O_5 status in the two soils were also judged from the fact that the yields due to NPK and NP in soil (1) were comparable to NK and N in soil (2) respectively. The percentage rise in yields due to the addition of P were as follows in the first and second soil respectively.

	Soil 1.	Soil 2.
Percentage increase from control to P.	34%	20%
„ „ „ N to NP.	105%	48%
„ „ „ NK to NPK.	74%	56%

The effect of P in increasing the crop yield was more pronounced in the soil which was more deficient in this nutrient.

20. Influence of Fertilisers on Crop Yields, Crop Composition and Soil Fertility when Legumes are either included in or excluded from the Rotation. Part I. Crop Yields and Soil Fertility.

S. V. Desai, W. V. B. Sundara Rao *and* K. G. Tejwani, New Delhi.

These studies have been carried out in lysimeters where two systems of rotations were started in 1945-46 *Rabi*.

(a) Legume rotation—Berseem (1945-46 *Rabi*)—Cowpeas (1946—*Kharif*)—Wheat (1946-47 *Rabi*)—Cowpeas (1946 *Kharif*).

(b) Cereal Rotation—Wheat (1945-46 *Rabi*)—Maruwa (1946 *Kharif*)—Wheat (1946-47 *Rabi*)—Maruwa (1947 *Kharif*).

The treatments in legume rotation were no manure in lysimeter 1 and superphosphate in lysimeter 2. The treatments in cereal rotation were no manure in lysimeter 3, N as sulphate of ammonia in lysimeter 4, P as superphosphate in lysimeter 5, and NP in the above forms in lysimeter 6. The doses of fertilisers and other details were given in the detailed paper. Only the first crop in both the rotations was manured and the residual effects were studied on the succeeding crops.

The conclusions arrived at are summarised below :-

In the *cereal rotation* the N treatment gave better yield, (24% more) than no manure, P treatment gave slightly more yield, while NP treatment gave the best yield (70% over no manure). No residual effects were observed on the succeeding crop except that the wheat crop in the lysimeter where N treatment was given to the first crop,

gave 37% more yield than that obtained in untreated lysimeter and the crop in lysimeter 5 receiving P in first season gave 37% less yield than untreated lysimeter.

In the *legume rotation* P treated berseem in lysimeter 2 yielded 230% more fodder than that in untreated lysimeter 1. Succeeding cowpea in lysimeter 2 gave 103% increase over that in lysimeter 1, wheat in lysimeter 2 gave 21% less yield than that obtained from lysimeter 1. There was no residual effect on succeeding cowpea crop in 1947 *Kharif*.

Comparing the residual effects on the 3rd crop of wheat in the cereal rotation with those on wheat in legume rotation it was observed that the latter gave better yield than the former.

Another legume rotation was started in 1946-47 Rabi in lysimeters 7 and 9. Lysimeter 7 was unmanured and lysimeter 9 received P_2O_5. The seed rate was doubled. The P treated berseem gave 81% more yield than that obtained from unmanured lysimeter. The cowpea crop in lysimeter 9 gave 39% less yield than that in lysimeter 7. The wheat crop in lysimeter 9 gave 28% more yield than that obtained from lysimeter 7.

As the 2nd series of cereal rotation in lysimeters 3, 4, 5, and 6 was started at the time the residual effects were being studied in lysimeters 7 and 9, we had an opportunity to compare the direct effects of manuring wheat with the residual effect of manuring berseem on the third crop of wheat in the rotation. The direct effects of manuring wheat were similar to those observed earlier. The wheat in the legume rotation gave better yields than wheat in NP treatment which was the best among the cereal rotation treatments.

From this investigation it is felt that it is possible to build up soil fertility by introduction of legumes in the rotaion and possibly more so by phosphatic fertilization of legumes. By introduction of legumes in the rotation we get more fodder for animals and more food for man from the same area of land and still we maintain and improve the soil fertility better than that when we practice a purely cereal rotation.

21. Influene of Fertilisers on Crop Yields, Crop Composition and Soil Fertility when Legumes are either included in or excluded from the Rotation. Part II.: Crop Composition, Removal of Nutrients by the Crops and Crop (wheat) quality.

W. V. B. Sundara Rao, S. V. Desai *and* K. G. Tejwani, New Delhi.

The fertiliser treatments and cropping systems and their influence on crop yields are described in Part I. In this paper the influence of fertilisers and different rotations on the crop composition, removal of nutrients by the crops and crop (wheat) quality are described.

1. In the cereal rotation NP-treatment increased the N and P_2O_5 content of wheat grain (1945-46) and removed maximum amount of N, P_2O_5, K_2O and CaO from the soil. Wheat from this treatment was best in quality with maximum protein content, maximum test weight and very good general appearance. No residual effects of manuring were observed on the succeeding maruwa crop (1946) and adverse effects of P application singly were observed on wheat following maruwa.

2. In legume rotation P fertilisation of berseem (1945-46) increased the P_2O_5 content. While a dose of 100 lbs. P_2O_5 per acre did not increase the CaO content, a dose of 200 lbs. P_2O_5 per acre increased it. The nitrogen content was unaltered. These treatments enabled berseem to remove N, P_2O_5 and CaO in larger quantities than those removed by untreated berseem.

Cowpeas (1946) after P treated berseem removed more N, P_2O_5, K_2O and CaO than that following untreated berseem.

Wheat (1946-47) following cowpeas after P treated berseem removed less quantity of nutrients than that following cowpeas after untreated berseem.

3. However the nutrients removed by wheat in either of the treatments in legume rotation were more than those removed by the 3rd crop wheat (1946-47) in

any of the lysimeters devoted to cereal rotation when the residual effects of manuring the 1st wheat crop (1945-46) were in evidence.

4. Berseem seed rate was increased to 60 lbs. per acre in a new series of legume rotation started in 1946-47 in lysimeters 7 (unmanured) and 9 (P treated) since it was felt that 30 lbs. seed rate used earlier was not enough to build up better fertility in P treated lysimeter than in untreated lysimeter as judged by the yields of wheat crop following cowpea after berseem. As in the earlier experiments, P treated berseem (1946-47) removed larger amounts of N, P_2O_5, K_2O and CaO than untreated berseem. Cowpeas (1947) following the P treated berseem removed less amounts of nutrients than those removed by cowpeas after untreated berseem.

5. Wheat (1947-48) in P treated berseem rotation removed more nutrients and was of better quality as judged by test weight, protein content and general appearance than wheat obtained from untreated berseem rotation.

6. Berseem was grown in 1947-48 in lysimeter 1 (untreated) and P (super at 200 lbs. P_2O_5 per acre) to see whether this dose of P_2O_5 would give increased yield of berseem, cowpeas and wheat, as with 100 lbs. P_2O_5 dose, in one trial (1945 to 1947). yield of cowpeas (second crop in the rotation, 1946) crop were more and yield of wheat (1946-47, 3rd crop in legume rotation) were less and in the other (1946 to 1948) cowpeas (second crop in the rotation, 1947)and wheat (third crop in the rotation, 1947-48) were greater than the yield of corresponding crops in unmanured berseem rotation. This rotation is in progress.

7. In 1947-48 the residual effects on wheat in legume rotation in lysimeters 7 and 9 and the direct effects of manuring with O, N, P, and NP on the wheat crop in the cereal rotation (1st crop in the second series of cereal rotation) were studied. It was observed that wheat grain in legume rotation removed more nutrients and gave grain of better quality than wheat grain of any other treatment in the cereal rotation.

8 From this investigation it is felt that it is possible to build up soil fertility by introduction of legumes in the rotation and possibly more so by phosphatic fertilisation of legumes. By introduction of legumes in the rotation we get more nutritious fodder for animals and more nutritious food for man from the same area of land and still we maintain and improve the soil fertility better than that when we practice a purely cereal rotation.

22. Influence of Fertilisers on Crop Yields, Crop Composition and Soil Fertility when Legumes are either included in or excluded from the Rotation. (Lysimeter studies). Part III. Soil and Leachate Analysis as a Measure of Soil Fertility.

K. G. Tejwani, W. V. B Sundara Rao *and* S. V. Desai, New Delhi.

The fertilizer treatments and cropping system are described in part 1 of the investigations.

The conclusions arrived at in connection with soil analysis and amount and nature of leachates obtained in differently treated and cropped lysimeters are discussed in this paper.

The main conclusions are summarised below :—

Soil analysis :

(1) The crops grown on soils under investigation gave a response to the addition of phosphate even though the soil contained more available P_2O_5 than the known limiting value (0.01%). This indicated the need for refixing the limiting values for various nutrients for different crops and soils.

(2) The differences in soil fertility status of lysimeters differently treated and cropped could not be obtained by chemical analysis of soil analysed by the known methods. However, these differences were best illustrated in the crop responses and removal of nutrients by the crops. In view of this the soil samples will be taken at longer intervals and not every season.

Leachate analysis—

(3) Leachate was obtained only during *kharif* season (May to October) period of heavy rainfall in Delhi.

(4) Leachate obtained in the years 1946 and 1947 was not large whereas the same obtained in 1948 was considerable in amount. The follwoing observations may be made on the analytical data of leachate obtained in 1948 *kharif*.

(a) Cereal rotation lysimeters gave more leachate than that given by legume rotation lysimeters.

(b) Nitrogen in the Leachate was in the form of Nitrate, Ammonical nitrogen being absent.

(c) Among the bases calcium was found in largest quantities.

(d) Potassium and phosphate were absent.

(e) There was more loss of calcium in lysimeter treated with sulphate of ammonia and this loss was reduced when superphosphate was added along with sulphate of ammonia.

(f) In legume rotation also the loss of calcium was more in untreated lysimeter than in P treated one.

(g) Loss of calcium in legume rotation was much. Less than that in cereal rotation.

23. Virus Diseases of Indian Potatoes.

PUSHKAR NATH, Simla.

Out of 28 distinct varietes of potatoes under commercial use in this country 24 were individually studied at the Simla Potato Breeding Station for presence of leaf-roll, virus X and virus Y.

Leaf-roll was found to be the most common cause of degeneration of seed-stocks. While most of the varieties when infected showed a marked reduction in vigour yet a few of like *Phulwa* (Variety 1), *Italian White Round* (Variety 20) appeared to be highly tolerant. Out of 24 varieties examined, 23 were found to be susceptible and only one type *Sathoo* (Variety 12) was highly resistant under field conditions.

Sixteen varieties were found to be susceptible to virus X and in the remaining no virus X has yet been recovered. Virus X by itself did not appear to cause markedly severe effects.

Virus Y was recovered from 19 varieties and, in many cases, in combination with virus X. Effects of virus Y were usually severe. The infected plants showed severe mottling and reduction in vigour. In combination with virus X it often caused severe rugose mosaic.

While presence of virus A was established it has not yet been studied in detail. It usually appears in combination with virus X, thus causing severe crinkle disease of the potatoes.

24. Studies on Penicillin Producing Strains of *Penicillium notatum chrysogenum* Series in India.

M. L. GATTANI *and* T. N. KAUL.

Studies were undertaken to produce penicillin producing strains of *Penicillium notatum chrysogenum* series at the Indian Agricultural Research Institute, New Delhi. To find out the incidence of *Penicillium* in soil throughout the year soil samples collected from potato fields of the farm and behind the Mycology Division, I.A.R.I. were plated out on Lipman and Browns synthetic medium. A seasonal variation in the incidence of *Penicillium* was noticed. Penicillium was abundant in soil samples collected during

November and March, where as no *Penicillium* was obtained from samples collected during the second half of May, June and July. During these months, Aspergilli and specially *Aspergillus niger* was the most predominant fungus. Isolated colonies of *Penicillium* were first of all obtained from soil samples collected during August.

A number of strains of *Penicillium* were next isolated from soil samples collected from different parts of the plains of Nothern India during winter. This was made possible by making soil streaks on a selective medium, potato dextrose agar containing common salt in the proportion of three mols of common salt to a litre of the medium.

The strains so isolated were tested primarily for their penicillin producing ability. For this a simple apparatus was devised in the Mycology Division. It consists of a $15'' \times 4''$ bottle from which the bottom has been removed. The bottle is fitted with an atomizer containing a twentyfour hour old culture of *Staphylococcus aureus*. Petri plates with three equidistant markings on rim and containing a four day old culture of the strain of *Penicillium* isolated from the soil are attached to the bottomless end of the bottle. In order to ensure uniform distribution of the bacterium the experimental plate is so arranged that one of the marks coincides with another mark made on the end of the bottle. A spray is then given by the atomizer, the plate rotated one third its circumference, adjusted a second time and the process repeated so that each plate receives three sprays. The plates so sprayed are incubated at 37°C and the the strains producing inhibitory zones are selected. So far twentyfive strains have been selected and some of them appear to be very promissing with regard to penicillin production. Further studies are in progress.

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ABSTRACTS

SECTION OF PHYSIOLOGY

President : Dr. B. B. Sarkar, D. Sc., F. R. S. E.

1. Comparison of Invertase Activity of dried yeast with that of the purified Enzyme.

M. M. Biswas, Calcutta.

100 gms. dried Brewers' yeast powder was mixed with 150 c.c. water and the paste formed treated with 20 c.c. toluol and stirred with a rod at 30°C. for ½ hr. to make a thin sludge. On autolysis the mixture was diluted with 200 c.c. water at 30°C. and kept for 1 hour. 4 c.c. toluol was added and this autolysed mixture was used for experiment. Portion of this mixture was filtered with kieselguhr under suction. The filtrate was examined for Invertase activity. Residue on the filter was extracted with water, treated with acetic acid to remove the proteins and after filtration with Kieselguhr was neutralised with ammonia. This filtrate was also tested for Invertase activity. Proportion of yeast powder and amount of glucose liberated were plotted in each case. Curves show the superior Invertase activity of crude yeast powder and the richer percentage of enzyme in the primary extract than in the secondary one.

2. On the Deterioration of Pepsin in Solution.

U. P. Basu *and* N. Ray, Calcutta.

Pepsin, though not unstable in dry condition is extremely unstable and susceptible to chemical alterations in solution. It is destroyed by alcohols, acids, alkalies, heavy metals and excessive heat. In ensuring its potency in any pharmacopoeial preparation the National Formulary (Eighth Edition, 1948) prescribed double the amount of pepsin claimed. Horkheimer (*Chem. mbs.*, 1936, **30,** 4622) found that incorporation of tannin with 3 per cent alcohol ensures the stability. Working with a granular variety of pepsin (1 : 10,000) it was noticed in the laboratory that the pH of the solution of pepsin is much more important for stability of the enzyme. The nature of anion plays no appreciable part in its deterioration on storage. Alcohol as well as dissolved oxygen tends to inactivate pepsin in solution. The addition of suitable antioxidants like ethyl galbate helps in preserving the enzyme in elixir.

3. Effect of Sodium Acetoacetate on the Enzymetic Hydrolysis of Polysacharides.

M. C. Nath *and* V. G. Hatwalne, Nagpur.

(1) The amylolytic activity of takadiastase on starch and glycogenolysis in rat liver (by perfusion experiments) were studied under the influence of Na-acetoacetate.

(2) Na-acetoacetate was found to inhibit the hydrolysis of starch at and above 0.0004M concentration. Below this conc. it was accelerated to a very small degree.

(3) Glycogenolysis in rat liver has been shown to be accelerated by Na-acetoacetate.

(4) The enzymetic breakdown of vegetable and animal starch is affected differently by aceto acetate ; while the former is inbibited the latter is accelerated.

(5) The depletion of glycogen content and formation of more sugar than can be utilised in the case of a diabetic patient has been explained through the data obtained in the perfusion experiment with liver.

4. Thiamine Hydrochloride and its Deterioration.

N. Ray, Calcutta.

It is known that thiamine hydrochloride undergoes deterioration in solution. Working in this direction it is being observed that apart from the pH of the solution the dissolved oxygen and traces of heavy metals also play a significant role in its change. The mode of such alteration has been discussed and a modified method of its easy estimation by the iodometric titration after oxidation of the Vitamin with alkaline potassium ferricyanide has been offered.

5. Radioactive Methionine and Detoxication of Bromobenzene.

D. P. Sadhu, Calcutta.

Rats were fed methionine with radioactive sulphur of 4,000—5,000 counts/minute. They were, besides, fed either bromobenzene mixed with cotton seed oil or cotton seed oil alone. These were killed after 24 hours and radioactivity estimated in blood plasma, liver, muscle, kidney and intestinal mucosal proteins and in the inorganic sulphate and total sulphur of urine.

About 18 per cent radioactive sulphur is excreted in urine of normal rats, while 25 per cent is excreted after feeding bromobenzene...This indicates that more methionine is converted into cysteine, if there is an immediate need for it in emergent conditions. Standard specific activity (SSA) in different body proteins shows very little significant difference, although it tends to be higher in liver in bromobenzene feeding where most of the detoxication and conversion of methionine into cysteine occurs. SSA tends to be lower in intestinal mucosa and plasma, which latter is in dynamic equilibrium with tissue proteins. Thus the incorporation of methionine into tissue proteins is retarded when there is extra demand for conversion into cysteine.

6. Cysteine-Methionine Inter-relationship.

D. P. Sadhu, Calcutta.

Two groaps of rats were fed methionine with radioactive sulphur with a total count of 9050 per rat per minute, one group, besides, being fed a 2 per cent cystine diet. Radioactivity was estimated in brain and the proteins of blood plasma, liver, muscle, kidney, intestinal mucosa and in the inorganic sulphate and total sulphur of urine, 24 hours after feeding radioactive methionine. Cystine-fed rats had a high count in urinary total sulphur and inorganic sulphate and a low count in tissue proteins. This appears to indicate that

it is not methionine, but largely its final product cystine, that is incorporated in tissue proteins and if cystine is already fed in excess in diet, methionine is excreted partly as neutral sulphur and partly oxidised as inorganic sulphate and excreted in urine. Kidney proteins show an increase in count in cystine-fed rats due presumably to the fact that more of the methionine fed was being excreted than in the control group. Brain also shows an increase in count probably due to the formatioj of a larger amount of sulpholipides in the cystine-fed rats and partly to retention of methionine-metabolic products in the brain tissue, where dynamic exchange may be less pronounced.

7. Glucuronidase Activity under different conditions.

D. P. Sadhu, Calcutta.

Glucuronidase activity was estimated in liver homogenates of albino rats by measuring the quantity of phenolphthalein liberated from phenolphthalein glucuronide. Young rats fed 10% tyrosine had a higher activity than the normals, this being corrected by feeding thiourea, though not thiouracil. Vitamin A–deficiency raises the activity, while hypervitaminosis A lowers it. Adult rats show similar but lesser changes. Difference in action between the two goitrogens, thiourea and thiouracil, is probably due to the structure of thiouracil being similar to that of tyrosine and both are probably excreted is glucuronide.

8. Tyrosine Toxicity in Young Rats.

D. P. Sadhu, Calcutta.

Tyrosine fed in excess (10% of diet) produces pathological symptoms in young albino rats of about 3 weeks, as loss in weight, exudative blepharitis, lesions in cornea, etc. The condition is not improved by feeding 0.2% ascorbic acid, slightly improved by feeding 500 I. U. of vitamin A, markedly improved by 0.2% thiourea or thiouracil, though less so by thiouracil, but worsened by feeding thyroid powder. Amino acid imbalance produced by feeding 10% glycine or glutamic acid in the diet had no effect other than a smaller gain in weight. Histological examination of rat thyroid, fed tyrosine shows marked cellular hyperplasia with very few vesicles.

Tyrosine toxicity in young rats appears to be mostly due to marked thyroid hyperplasia and increased secretion of thyroid hormone. Goitrogens as thiouracil and thiourea improve the condition by depressing the overactivity of thyroid. Difference in action between thiourea and thiouracil is probably due to difference in chemical structure, thiouracil being similar to tyrosine.

9. Studies on Riboflavin Excretion by Normal Indian Adults.

B. V. Rama Sastri *and* V. N. Patwardhan, Nutrition Research Laboratories, Indian Research Fund Association, Coonoor.

There is much individual variation in the twenty four-hour urinary excretion of riboflavin. The range of fifty observations on 24-hour urinary excretion of riboflavin was found to be

343-4401, μg., the average being 1313 μg. Riboflavin excretion per unit volume of urine shows less variation, the range being 0.26 to 0.92 μg. per ml., the average being 0.58 μg. per ml. A large majority (about 75%) of the excretions fell between 0.3-0.7 μg. of riboflavin per ml. of urine. The values of riboflavin per ml. in fasting one hour samples agreed well with the corresponding figure calculated from the twenty four-hour excretion by the same subjects on unrestricted diet.

These observations confirm some previous findings that twenty four-hour urinary riboflavin excretions have got limited significance. There seems to be some justification for considering the riboflavin excretion per unit volume of urine in a fasting one hour specimen as an index of the level of riboflavin excretion in normals.

10. Study of the Bio-Chemical Aspect of Etiology of Phrynoderma.

P. G. Tulpule *and* V. N. Patwardhan, Nutrition Research Laboratories, Indian Research Fund Association, Coonoor.

In recent years evidence has been produced which throws doubt on the accepted hypothesis concerning the etiology of Phrynoderma (Follicular Hyperkeratosis). The question has been raised whether it is due to a simple deficiency of vitamin A or there are some other factors involved such as the related deficiencies of certain members of vitamin B_2 complex and essential fatty acids.

Taking into consideration this controversy, an investigation of the biochemical aspects of the disease has been undertaken. So far, nine patients have been studied. Analysis of the blood for lipoids—total lipoids, cholesterol, total fatty acids and Iodine Number of total fatty acids—and carotene and vitamin A were made before instituting the treatment. It was observed that the Iodine Number of the fatty acids of blood was considerably lower in phrynoderma patients although the total lipoids and cholesterol content of the blood was practically normal, indicating some disturbance in fat metabolism. The range of the Iodine Number of blood fatty acids in normals has been observed to be between 108 and 135 as against 74 and 87 in the patients suffering from phrynoderma. The clinical response of patients treated with shark liver oil from which vitamin A was destroyed has been favourable. It is intended to analyse the blood lipoids after the treatment is complete.

11. Poor Indian Diets and Adult Hepatic Chirrhosis.

P. K. Vijayaraghavan *and* V. N. Patwardhan, Coonoor.

Inspite of extensive work on the effect of various dietary factors on liver disease, doubt still exsists regarding the exact conditions resulting from nutritional deficiencies, which lead to hepatic cirrhosis and necrosis. With a view to studying the role of poor Indian dieteries in the production of portal cirrhosis certain experiments were started. Albino rats, four weeks old, were fed on poor Indian diets based on rice and wheat respectively. Metabolic studies consisted in determining urinary Nitrogen, fecal nitrogen, and total sulphur and SO in urine. Studies on liver consisted of the determination of total crude fatty acids, total protein, carotene, vitamin A, thiamin and riboflavin at the end of 2, 4, 6 and 9 months.

The total crude fatty acids of liver of the animals kept on the South Indian diet, with 10% protein and low fat content, after an initial increase diminished after six months. But in wheat diet I, which had the same protein and fat level, the lipid content showed a steady increase. Wheat diet II, having a slightly higher protein content, also showed a steady increase during this period. In the control group, however, there was only a slight increase.

It is interesting to note that on both rice and wheat diets liver fat increased to 10% or over, although the dietery fat was in the neighbour of 4%. In the rice diet the liver fat started fallingtill the end of nine months it approximated the fat content of livers on the stock diet. Whether these changes in the liver are accompanied or followed by structural changes will be revealed by the histological examination of liver, which is being carried out.

12. Conversion of Carotene to Vitamin A.

A. R. Sundararajan, Nutrition Research Laboratories, Coonoor.

It was assumed till a couple of years ago that liver is the principal seat of conversion of carotene to vitamin A in the animal body. Recently some evidence has been brought forward to show that intestinal wall may be a site of conversion when carotene is ingested. The following experiments were carried out to locate the exact site of conversion.

Vitamin A-deficient young rats were divided at random into three groups. The first group received only ten drops of gingelly oil containing 0.5% of a-tocopherol acetate ; the second received 4.375 mg. of carotene (88% B-carotene) dissolved in 10 drops of gingelly oil. The third group received the same solution as the second but with a prior dosage of sulpha suxidine for two days. The rats were killed at varying intervals of time and the organs assayed for carotene and vitamin A.

Vitamin A appeared in large amounts in the lumen of the small intestine up to 5 hours. During this period, there was no increase in liver of either carotene or vitamin A after the fifth hour, up to 48 hours, liver vitamin A increased while that of the small intestine (wall and contents) returned to the pre-dose level. Although the vitamin A levels of the wall of the small intestine also increased with that of its contents, the figures for the latter were far in excess of the former. It is concluded that in the vitamin A-deficient albino rat, when carotene is fed by mouth, its conversion to the vitamin takes place in the lumen of the small intestine and that the liver acts only as a storage organ. Further investigations are in progress.

13. Impairment of Antibody Production during Vitamin B6 deficiency in the Chick.*

P. S. Sarma, Nutrition Research Laboratories, Coonoor.

It has been shown by several workers that a relationship exists between the state of nutrition and antibody production in the rat. Thus Stoerk and coworkers and Axelrod

*(This work was carried out in the Department of Nutrition, Haward University School of public health, Boston, Massachusetts.)

and others have found that in vitamin B- deficiency in rats the production of antibodies is slowed down to a considerable extent. A significant decrease also takes place in the thymus weights of these deficient rats.

It was felt that these results needed confirmation in another species of experimental animals. It was found that chicks normally possess a high antibody titre against washed sheep blood erythrocytes. Day old chicks were fed chline deficient diet, pyridoxine deficient diet and pyridoxine deficient diet to which desoxy-pyridoxine, the anti-vitamin, was added in suitable amounts. When the chicks exhibited signs of vitamin deficiency, washed sheep blood erythrocytes were injected and the haemagglutinins were determined after an interval of five days. The thymus, spleen and bursa Fibrici were also removed from each chick and their weights determined. The results clearly demonstrate that during vitamin B-deficiency, there occurs an impairment of antibody production and the weights of thymus, spleen and Bursa Fabrici also get reduced to a considerable extent. No such changes were observed during choline deficiency in the chick.

14. Studies in Perotic Chicks with Radioactive Phosphorus.*

P. S. Sarma, Nutrition Research Laboratories, Coonoor.

Chicks suffer from perosis or slipped tendon during several different types of nutritional deficiencies. This disease involves the bones and has some counterpart in certain bone diseases of children. Perosis is very marked in two entirely unrelated deficiencies, one a mineral deficiency—(manganese deficiency) and the other a vitamin deficiency (chlorine deficiency). It was therefore thought that a study of phosphorus metabolism in the bone could best be studied using radioactive phosphorus. Day old white Leghorn chicks were kept on purified rations deficient in chlorine and manganese respectively. When the chicks developed perosis, 50 microcuries of radioactive phosphorus was injected into the chicks and the chicks were then sacrificed at definite intervals of time. The tibia were removed, the organic and inorganic forms of phosphorus seperated and the radioactivity of samples determined with the aid of a Geiger-Muller counter and an autoscalder. Phosphatase activity was also determined in the serum of the chicks. The results obtained indicate that in perotic chicks, the rate of phosphorus turnover is far below that of normal animals. Further, the livers of choline deficient chicks are not fatty and the phosphatase activity of their sera is abnormally high. In contrast, the serum of manganese deficient chick was found to be abnormally low in phosphatase activity. These results has been discussed in their relation to the deposition of calcium and phosphorus in the epiphysis of the bones of chicks suffering from choline and manganese deficiencies.

*Work carried out in the Department of Nutrition of the Haward University School of Public Health, Boston, Massachusetts).

15. Pyridoxine and Linoleic Acid Metabolism.*

P. S. Sarma, Nutrition Research Laboratories, Coonoor.

Several workers have studied the relationship between pyridoxine and linoleic acid metabolism, but the exact nature of such a relationship has not been completely elucidated. In this paper, observations have been made on the occurrence of ring tail dermatitis in rats and on the growth retardation in chicks, which contribute additional evidence as regards the disturbance of linoleic acid metabolism during pyridoxine deficiency in both the rat and the chick. When Desoxy pyridoxine was added to a vitamin B- deficient diet at a level of 1 mgm. per 100 gm. of diet, Young growing rats invariably developed ring tail dermatitis along with the usual signs of vitamin B- deficiency within a very short period of three to four weeks. Ring tail dermatitis, popularly known as the 'Burr and Burr' syndrome is caused by a deficiency of linoleic acid and the observations carried out lead one to conclude that desoxy pyridoxine not only induces a severe derangement of tryptophane metabolism as indicated by an increased excretion of xanthurenic acid in the urine but also causes a disturbance in the normal metabolism of linoleic acid. The relationship between linoleic acid and pyridoxine has also been observed in chicks fed on diets deficient in pyridoxine and linoleic acid, the growth retardation of chicks on a combined vitamin B- deficient and linoleic acid deficient diet being greater than on vitamin B- deficient diet alone. No such difference in growth was observed in other vitamin deficient diets when linoleic acid was omitted from them.

16. Vitamin B Complex and Cutaneous Nutrition.

D. P. Sadhu, Calcutta.

Most of the works on the effect of vitamin B complex deficiencies on skin have been carried out with yeast as a source of vitamin B complex, but as it contains many substances, including protein and other unknown factors and as it is difficult, if not impossible, to produce pure single vitamin deficiency with yeast as a source of B vitamins, an experiment was undertaken with pure synthetic B vitamins in the diet.

Young albino rats of 40—50 gm. weight were placed on a purified diet, each group receiving all the pure vitamins except the one vitamin, to which they were to be made deficient. Five groups of rats were used, one serving as control which received all the B vitamins. Though the synthetic diet was optimal, it did not produce maximal growth. Thiamine-deficient rats had no cutaneous lesion except one rat in the group which showed some denudation of the neck and part of the thorax. Riboflavin-deficient rats did not show any skin lesions whatsoever. Pyridoxine-deficient rats started showing thinning of fur from the 8th day, red whiskers on 30th day, inter-digital reddening of legs on 44th and scaly paws on 60th day. Pantothenic acid-deficient rats were like the pyridoxine-deficient ones, but showed more extensive alopecia, involving not only the throat, but also abdomen and even the hind

* (This work was carried out in the Department of Nutrition, Harvard University School of Public Health, Boston, Massachusetts.)

The cutaneous nutrition is a function of both pyridoxine and pantothenic acid, the other vitamins as riboflavin and thiamine being not responsible for the nutrition of the epidermis.

17. Studies in Manganese Matabolism.

M. N. Rudra, Darbhanga.

The conditions which govern the retention of manganese by the tissues of animals have been studied. A group of white rats fed a basal ration and sodium-bicarbonate retained only 0.18 mg. of the 0.5 mg. manganese given to each daily. A similar group of rats given the same ration and manganese but ammonium chloride instead of sodium bicarbonate retained daily .30 mg. of the 0.5 mg. manganese given. The increased retention is statistically significant showing that acid condition favours retention of manganese by tissues. In both groups most of the manganese is excreted in the faeces. In the former .31 mg. (96.3%) of the excreted manganese is in the faeces and .012 (3.7%) in urine. The corresponding figures for the latter are .21 mg. (98.2%) and .004 mg. (1.8%) respectively.

18. Studies on Indian Edible oils—Sesame oil.

K. Rama Murti *and* B. N. Banerjee, Department of Biochemistry, Indian Institute of Science, Bangalore.

Samples of sesame oil obtained from all over India have been studied with special reference to the effect of the free fatty acid content of the oil on its digestibility, and the stability of carotene when dissolved in it. The values obtained have been compared with those of groundnut oil. It was observed that in the case of sesame oil there was a lower digestibility and greater in-activation of carotene as the f.f.a. of the oil increased. An oil of less than 1% f.f.a. showed digestibility comparable to that of fresh oil obtained from healthy seeds and caused very little inactivation of carotene. For the same degree of acidity, there was lower digestibility and greater inactivation of carotene in the case of sesame oil than in the case of groundnut oil. This can be explained as being due to the differences in the glyceride structure and unsaponifiable portions of the two oils. Experiments in this direction are under progress.

Experiments are also being conducted to study the stability of vitamin A in high f.f.a. sesame oil and the preservation of the latter with antioxidants.

19. Growth of Fibroblasts in Tissue Culture under the action of Vitamins.

N. N. Das, Department of Physiology, Calcutta University.

Hanging drop preparation of tissue culture from six day old chicken embryo showed marked differention in the fibroblastic growth under the influence of vitamin mixtures (A.B.C.D.). The growth was nearly double, after 48 hours incubation in the vitamin treated cultures. The vitamin treated cultures can be kept for a longer period than the untreated ones and are more resistant to infection. The applications of different concentrations of vitamins have been studied. The larger doses of vitamins have a lytic action on the fibroblastic growth. Further work on the action of individual vitamins is in progress.

20. Studies on the Mechanism of Alloxan Hypoglycemia.

Sachchidananda Banerjee, Calcutta.

When alloxan is injected intravenously in rabbits an initial hyperglycemia is followed by a transient hypoglycemia leading to death of the animals from hypoglycemic convulsion. If the hypoglycemia is prevented by repeated intravenous injections of glucose, animals survive and permanent hyperglycemia and diabetes develops in the animals. The transient hypoglycemia has been claimed to be due to leacking out of insulin into the circulation from the pancreas. Some workers, however, think that the transient hypoglycemia is extrapan creatic in origin. To throw some light on the mechanism of alloxan hypoglycemia the following experiments have been undertaken : Alloxan (200 mg. per kilo) was injected intravenously in four rabbits which were starved and which received a daily injection of 100 mg. of phloridzin for a period of seven days. The injection of alloxan produced an an initial hyperglycemia but no hypoglycemia was observed in any one of them. Twenty-four hours after the injection of alloxan all the rabbits excreted sugar in the urine and their fasting blood sugar level was high. Alloxan was injected in two rabbits made diabetic by a previous injection of alloxan. The injection of alloxan caused a further rise in the blood sugar level and even six hours after the injection of alloxan the blood sugar level was much above the fasting blood sugar value. Glucose tolerance tests were performed in a rabbit, both before and after the animal was phloridzinised and starved for seven days. A diabetic type of glucose tolerance curve was observed when the animal was phloridzinised and starved. The implications of the above results will be discussed.

21. Vitamin C and Thyroid.

Sachchidananda Banerjee *and* Naresh Chandra Ghosh, Calcutta.

Patients with hyperthyroidism have high blood sugar and show a hyperglycemic reaction after glucose. These are reduced after thyroidectomy. Thyroidectomy increases the carbohydrate tolerance and diminishes the insulin requirements of diabetic patients. Yhe glycogen value of the liver of animals are diminished when fed thyroid and increased when fed thiouracil, which is an antithyroid agent. It has been observed by us that scorbutic guinea pigs show a diminished sugar tolerance and diminished glycegen value of the liver. The metabolism of thyroid gland, therefore, might be disturbed during scurvy. The effect of feeding thyroid and methyl-thiouracil, an anti-thyroid agent, on the altered carbohydrate metabolism as observed in scurvy, have therefore, been investigated. Six groups of guinea pigs were placed on six different diets for a period of three weeks. The diets were (1) Scorbutic diet only; (2) Scorbutic diet containing 1 per cent methyl thiouracil; (3) scorbutic diet with 0.05 per cent thyroid ; (4) scorbutic diet with a daily supplement of 5 mg. of ascorbic acid per animal ; (5) Scorbutic diet with methyl thiouracil with a daily supplement of ascorbic acid and (6) scorbutic diet with thyroid with a daily supplement of vitamin C. The animals of all the groups were weighed wtice a week. Glucose tolerance tests were performed on the 22nd day of the experiment in all the animals of the different groups. The type of glucose tolerance curves of the three groups of guinea pigs, which received scorbutic diet, scorbutic diet with methyl thiouracil and scorbutic diet with thyroid, was more or less similar. The blood sugar values both before and for varying periods after the feeding of glucose did not vary significantly in these animals. This indicated that the deficient utilization of glucose as observed in scorbutic guinea pigs was not affected by either

hypo-or hyper-thyroidism. The blood sugar level three hours after feeding glucose, in guinea pigs receiving thyroid gland and ascorbic acid was significantly higher than the blood sugar level in guinea pigs which received no thyroid gland. This indicated that hyperthyroidism lowers the carbohydrate tolerance in guinea pigs. Methyl-thiouracil however, had no effect on the utilisation of glucose.

22. Supplementing Value of Calcium Fortified Groundnut Milk to a Poor South Indian Rice Diet.

M. N. Moorjani *and* V. Subrahmanyan. Department of Biochemistry, Indian Institute of Science, Bangalore.

It was shown that the groundnut milk has no supplementing value to a poor Indian diet. This is due to the fact that the milk is very deficient in calcium and that the proteins in the milk are of low biological value. An attempt was therefore made to study the supplementing effect of calcium fortified milk on poor rice diet. The fortified milk given as a, supplement to poor Indian diet increased the average weekly increase in weight of rates. from 2.5 to 6.2 gms. as compared with cow's milk where the average increase is 8.6 gmss The inclusion of 2% yeast into the milk gave still letter results.

23. Fortification of Groundnut Milk with Calcium and Study of its Availability to Young Albino Rats.

M. N. Moorjani *and* V. Subrahmanyan, Department of Biochemistry, Indian Institute of Science, Bangalore.

Groundnut milk is very poor in calcium (9 mgs. per 100 ml.) as compared with cow's milk (which contains about 120 mgs. per 100 ml.). An attempt was therefore made to fortify the milk with calcium in order to make it a nutritive article of human food. The incorporation of calcium into the milk offered some practical difficulties as th milk curdled on addition of even small amounts of calcium salts. The raising of pH of the milk from 6.0 to 6.6 and addition of 0.3 per cent of sodium citrate has a favourable effect on the calcium incorporation. Among the various calcium salts tried calcium glycerophosphate gave the best results. The milk was therefore fortified with calcium by incorporation of calcium glycerophosphate along with 0.3% Na-citrate at pH 6.6. The availability of calcium and phosphorus from fortified groundnut milk has been compared with those from cow's milk by conducting balance studies with young albino rats. It was found that the rats retained 72.7% of the calcium and 90.2% of phosphorus from groundnut milk, while the corresponding figures for cow's milk were 84.9 and 83 respectively.

24. Effect of Steaming on the Vitamin B-Complex of Groundnut Milk.

M. N. Moorjani *and* V. Subrahmanyan, Indian Institute of Science, Bangalore.

The overall vitamin B-complex value of groundnut milk has been estimated as being % of that in cow's milk. There the groundnut milk was used as such in the fresh form

having a nutty flavour. Subsequent investigation showed however that the flavour can be completely removed by steaming the milk for about half an hour, and the milk thus obtained after steaming was found to have an agreeable flavour and taste reminiscent of pasteurised cow's milk. The vitamin B-complex in groundnut milk both before and after steaming were compared with that of cow's milk by growth experiments on rats. The average increase in weight over seven weeks (from the commencement of milk administration) was as 65.3, 52 and 46 gms. in the case of cow's milk, fresh groundnut milk (unsteamed) and steamed groundnut milk respectively. There occurs a loss of about 11.5 per cent in the B-complex vitamin content of groundnut milk on steaming it for about half an hour. To make up for this loss it would be desirable to incorporate B-complexes in some suitable form after steaming the milk.

25. On the Inhibition of the Acidity of Gastric Juice by Ergotoxine.

B. P. Sinha, Darbhanga.

An experimental observation on two Pavlov and one Heldenhain pouch animals on the response of a single dose of Ergotoxine grain 1/100 administered subcutaneously just after the intake of standard quantity of beef without extractive, showed that the drug had a remarkable inhibitory effect in both the quality (in acidity) and quantity of the gastric juice. The effect of which persisted even up to three hours.

26. The Theory of the Alpha-Phonoid (A Study of Speech Structure).

C. R. Sankaran.

Professor A. GOMELLI'S latest experimental findings regarding the structure of speech elements are given. The 'higher generalization' due to the Alphaphoneme theory which leads to the conception of further refinement known as the 'Alpha-Phonoid' theory is discussed in the light of some topological concepts. The continuum of the CV configuration which the 'Alpha-Phonoid' theory involves is a many dimensional continuum, and is a topological structure of manifoldness. The epistemological implication of the conception is touched upon.

27. Role of Potassium in some Irregularities of Perfused Frog Heart.

N. P. Benawari, Laheriasarai, Behar.

A few years back, while working on perfused frog's heart, it was observed that during the months of August, September and early part of October, the perfused hearts showed certain pecularities not observed during the rest of the year. There was increased coagulation of blood and marked irregularity in the amplitude and rhyrhm of beat, mostly in the male frogs.

An interesting thing was observed in this connection that when such irregular hearts were perfused with Ringer containing excess of potassium (0.1% instead of 0.03% of KCl) the heart quickly stopped, as expected, but on reperfusion with ordinary Ringer, recommenced beating without irregularity.

It seems rather odd that in the perfusion of frog's heart, specially males an excess of potassium is necessary during the breeding season. It is likely that the excess of sex hormones in the blood during the breeding season keep the heart beating regularly, inspite of lowered content of potassium in the cardiac muscle. When the blood is replaced by ordinary Ringer, the heart become irregular due to the low content of potassium in the heart muscle, which can be corrected by increased amount of potassium in the perfusing fluid.

28. On the Assay of Liver Extracts—Part II.

A. N. Bose, Bengal Immunity Research Institute, Calcutta.

Biological assays of potent liver extract preparations are difficult in the laboratory. There is no universally accepted method for evaluating such extracts. Attempts have been made on pigeons and guineapigs. It has been reported (Jacobson & Williams, Brit. J. Path. Bact. 1945, 57, 101) that splenectomised rabbits give rise to a very high reticulocyte response to injection of potent liver extracts. In order to find whether such splenectomised animals could produce response suitable for biological assay, a number of experiments were carried in this laboratory. Three splenectomised rabbits (wt. 1.5 to 2 kg.) were subjected to repeated injections of potent liver extracts of different brands (Lily, B.I., T.C.F. Evans) and their responses compared with those after injection of Casein Hydrolysate containing equivalent quantity of nitrogen per c.c. It is being found that a definite qualitative response is available by this method of assay. Further work is on progress to study the quantitative response of these animals to injections of different doses of Liver Extract.

29. Effects of Methyl Ester of the Fatty Acid from the Oil of Bouchi on the Depigmentation of Skin.

N. N. Das, Department of Physiology, Calcutta University.

Leucoderma or the white skin due to depigmentation is a condition of metabolic error, the effect of some abnormal conditions either pathogenic or non pathogenic. The ailment sometimes subside but the white patches of the skin does not disappear. A few cases have been tried with intradermal injection of the methyl ester prepared from the fatty acids from the oil of Bouchi at the site of the white patches. Cases treated with oil injections were compared with cases treated with methyl ester. In the later cases better and quicker results were obtained than in the former. Moreover the injection of oil cause pain and irritation, whereas the injected methyl ester is quickly obsorbed and is less irritating.

30. Action of Jute Seed Bitter (Chorcorin) on Smooth Muscle.

Nirmal Kumar Sen *and* N. N. Das, Department of Physiology Calcutta University.

The action of Chorcorin on heart has already been studied. In the present paper its action on intestinal and uterine muscle has been studied. Strips of intestinal loop showed marked stimulation at perticular concentrations. A difference between the crude extract and the purified crystalline product has also been dealt with. The crude product contain certain other compounds which require further investigations.

31. Effects of Spirochin Hydrochloride on Toad's Heart and on the Blood Pressure of Cat.

S. R. Moitra N. N. Das *and* G. S. Chatterjee, Department of Physiology Calcutta.

Its theraputic action on the toad's heart and on cat's blood pressure was studied. The toad's heart was perfused containing different concentrations of the drug. The amplitude of the heart was found to be diminished proportionately with the increasing concentration of the drug in the perfusing fluid. With strong concentration of the drug (5%) the heart stopped completely, but revived again when perfused with Ringer. The drug was found to paralise the vagus nerve.

The action of the drug on the blood pressure of cat revealed that in small doses there is a slight fall of blood pressure lasting for a short time when injected into the vein. The pressure quickly came back to normal. The lethal dose for cat is 0.3 gm. to 0.35 gm. per kilo. Respiration failed before the heart. The action of Vagus on blood pressure was found to be depressed by the drug.

32. A Method for the Production of Carotene Concentrate from Water Hyacinth (Eichhornia Crassipes Solms).

S. Neogi *and* K. Rajagopal, Calcutta.

In quite recent years several research workers, notably Sankaran, G. (1948), Sen, K. C. (1944) and Banerji, B. N. (1946) have mentioned the possibility of commercial production of carotene from water-hyacinth. Water hyacinth is regarded as a pest and its eradication is a serious problem in Bengal. According to official report about 107 million tons of green leaves are easily available in the province. In this abstract a simplified method for the production of carotene concentrate which has been worked out has been presented which is applicable to its production on a commercial scale. The method as finally established briefly consists of (1) blanching of the thinly sliced green leaves in boiling water for 2 to 3 minutes, (2) dehydration in a forced draft type dehydration or water oven maintained at a temperature below 60°C for 4 to 5 hours, (3) extraction by heating in boiling flasks on water bath with (80° to 90°) petroleum ether of high boiling point (80° to 90°C), (4) chromatographic separation of carotenoid fractions from chlorophyll and other non-active components,

(5) concentration and recovery of solvent by distillation under reduced pressure, (6) preservation and storage in vacuum sealed brown glass bulbs. The yield by the method has been found to be an average of 85 per cent of the total carotene content of the leaves (Spectroscopic method). By working with 3 kg. quantities or green leaves an average of 140 mg. of purified production have been obtained in the laboratory. Varying conditions at different stages involved in the process have been studied. The treatment of blanching has been found to hasten dehydration at 60°C by about 60 per cent and raise yields of carotene by about 42 per cent when compared with those obtained without the treatment. The progress of dehydration has been followed and curves have been drawn on the data. In the process of extraction several types of apparatus have been used, *viz.*, glass soxhlet (2 litre), copper soxhlet (3 litres) and long necked boiling flasks (2 litres) fitted with upright bulb condensers, with low (40°—60°C) as well as high boiling (80°—90°C) petroleum ethers. Comparative studies show that 4.7 to 4.8 mg./100 g. (fresh basis) which is 84—86 per cent of the carotene con;ant can be attained with direct heating in boiling flasks using high boiling petroleum studies show that 4.7 to 4.8 mg./100 g. (fresh basis) which is 84—86 per cent of the carotene content can be attained with direct heating in boiling flasks using high boiling petroleum ether. In chromatographic separation a mixed absorbent consisting of soda-ash and magnesium oxide in the proportion of 6 : 1 has been devised. Soda ash has been selected as it is cheaply available and selective in absorption (Kernohan, G : Science 90, 623, 1939) for chlorophyll and other non-carotenoid pigments. The rate of percolation has been seen to be more rapid in comparison with other absorbents and the chance of isomerisation is thus much reduced. After use the adsorbent has been dired in air and revivified with heat and used again for adsorption. Growth curves of rats fed different amounts of the product prepared in the laboratory showed biological activity of the pigment. Experiments are in progress on the administration of the carotene obtained in the laboratory as supplementary feeds to school children.

33. Studies on the Chromatophorotropic hormone of the Pituitary Gland : Part I—Isolation and Purification of the hormone.

B. Ghosh, J. N. Karkun, D. P. Sadhu *and* B. Mukerji, Calcutta.

The Melanophore by different methods and its hormone supposed to be located in the intermediate to be of the gland was extracted activity measured biologically on the isolated skin of frog (Rana), using a methoid analogous to that described by Frieman, Fishbein and Hisan (*Arch. Biochem.* 1948, **17,** 183). An acetic acid (0.5%) extract of whole pituitary powder representing 1 mg. of powder per c.c. has been arbitarily chosen to represent a standard of 100% activity. Dilute pyridine extract showed 50% activity while dilute ammonia extract recorded even lower activity. Extraction of melanophore homone from acetone dried whole pituitary gland was found to give on an average 50% activity. An acetic acid extract of fresh whole pituitary gland of on, representing 17 mg. of fresh tissue per c.c., possessed 240% activity. A study of the physico-chemical properties of the acetic acid extract of melanophore hormone revealed the following facts. The optimum activity of the hormone remained at pH 4.0. Diminution of activity resulted when pH of the extract was either lowered to 2.0 or raised to 8.0. Melanophore hormone, though heat-stable, cannot stand prolonged heat-treatment even at as low a temperature as 40°C. Complete destruction of activity was noted when the acetic acid extract of the pituitary was subjected

to slow evaporation under hood at 40°C. Vacuum evaporation below 50°C caused slight but appreciable destruction of hormone activity. Different adsorbing materials like active charcoal, Decalso, Kaolin, calciumphosphate, permutit, and Kieselguhr have been tried. Active charcoal was found to adsorb completely the melanophore hormone. While Decalso was partially effective. Kaolin and Calcium phosphate were ineffective as adsorbing agents. Permutit, Fuller's earth and to a larger extent, Kieselguhr were capable of removing some associated pituitary constituent which seemed to possess anti-melanophore activity. Partial concentration of melanophore hormone by precipitation with acetone and ammonium sulphate has been effected. Acetone in sufficient quantity (1 : 4 by volume) was capable of producing precipitate which contained about 4.5 times melanophore activity as compared with that of the fresh tissue extract.

34. Chemotherapeutic action of Dimidium Bromide in T. Equiperdum and T. Evansi Infections.

B. N. Choudhury *and* B. Mukerji, Calcutta.

Wien (1) has studied the therapeutic activity of amidine and phenanthridinium compounds against T. congolense infections in laboratory animals. He has observed that phenanthridinium compounds which are highly active against T. congolense showed little activity against T. equiperdum in contradistinction to amidine compounds which show great activity against T. equiperdum but are ineffective against T. congolense. This observation led us to study the effect of Dimidium Bromide, a phenanthridinium compound, against T. evansi & T. equiperdum infections, the two strains maintained in our laboratory. The results are shown in Table I & II.

TABLE I.

Evaluation of the activity of Dimidium Bromide against T. evansi.

Dose—mg./gm.	No. of mice.	No. of mice cleared of Trypanosomes.	
		3 to 7 days.	28 days.
0.0005	4	0	
0.001	4	0	
0.005	4	0	
0.01	4	0	
0.02	4	0	
0.03	4	2	
0.04	4	3	
0.05	4	4	

TABLE II.

Evaluation of the activity of Dimidium Bromide against T. equiperdum.

Dose—mg./gm.	No. of mice.	No. of mice cleared of Trypanosomes.	
		3 to 7 days.	28 days.
0.01	2	0	..
0.02	2	0	..
0.03	2	0	..
0.04	2	1	..
0.05	2	2	2

From table I it will be observed that the E. D. 50 & C. D. 50 figures for T. evansi are 0.03 mg./gm. & 0.045 mg./gm. respectively. These figures are quite high compared to those for T. congolense (E. D. 50—0.00005 mg./gm. & C. D. 50—0.0004 mg./gm.—Wien (1)) and approach the toxicity figure by subcutaneous route (0.061 mg./gm. (Wien)—confirmed by us). The figures for T. equiperdium are almost identical to T. evansi figures.

The specificity of the action of the compound against particular strains of trypanosomes is well shown but the reason is not clearly understood.

35. The effect of germination, autoclaving and heat processing on the digestibility and the biological value of the Bean Proteins of Phaseolus Aureus Roxb and Cicer Arietinum L.

P. B. Sen *and* K. Mukherjee, Physiology Department, University College of Science, Calcutta.

These beans are consumed in many forms. Their digestibility and the biological value of their proteins have been investigated. It has been observed that there is no appreciable diminution of digestibility of Cicer arietinum and Phaseolus aureus protein during heat treatment, germination and autoclaving. The biological value of Cicer arietinum protein, definitely improves on heat treatment and germination but that of Phaseolus aureus protein is adversely affected by these procedures. Moderate autoclaving only increases the biological value of Cicer arietinum to a slight extent but Phaseolus aureus protein suffers a diminution in the biological value.

36. A study on the Toxycity and Cardiotonic Effect of a series of Pheynl Biguanide Compounds Synthetically prepared.

P. Ray *and* N. N. Das, Physiology Department University College of Science, Calcutta.

A series of Phenyl-biguanide compounds which were synthetically prepared were tested for the toxicity on paramecium and other animals and it was found that sulphates of the compound are more toxic than hydrochlorides. One of the compounds p-dydroxy phenyl-biguanide hydrochloride has a great stimulating action on heart. It was found that a perfused heart beating feebly can be revived and kept going for a much longer period under the effect of the drug. A study of the subject is in progress.

37. Assay of Commercial Samples of Crystalline Penicillin.

J. N. Basu *and* J. C. Pal: Calcutta.

Chemical methods of Sheehan *et al* (J. C. Sheehan, W. J. Mader, and D. J. Cram. J. Amer. Chem. Soc. 1946, **68,** 2407) and of Alicino (J. F. Alicino. Ind. Eng. Chem., Anal. Edu. 1946, **18,** 619) were tried on a munber of commercial Samples of Crystalline Penicillin G. and the results obtained were comparable with those obtained by the usual "Cup & Plate method" of microbiolgical assay, as modified by Heatley (N. G. Heatley, Biochem. Jour. 1944, Vol. 38, No. 1, p. 61). Of the two chemical methods, that of Sheehan *etal* utilising the formation of N-ethylpiperidine Salt of Penicillin G is recommended to be adopted for the assay of commercial Penicillins, as this method gives the best chance of anomalous conclusions being drawn on account of interference with other products.

38. Haematological picture of normal adult people of both sexes in Orissa.

S. M. Banerjee, S. Tej and J. Senapati,
Orissa Medical College, Cuttack.

Values regarding R.B.C. total count, W.B.C. total and differential count, M.C.H., M.C.V., blood Sedimentation rate, etc., have been obtained from 50 apparently healthy college students of both sexes. Some of the values show wide variations from normal for example high B.S.R., macrocytic anaemia and Eisophilia without symptoms. It is proposed to extend the work to all age groups of sufficient number of cases so as to enable to establish normal values and to ascertain causes of gross abnormalities.

SECTION OF PSYCHOLOGY & EDUCATIONAL SCIENCE

President:—Prof. T. K. N. Menon, M.Ed.

I. General and Experimental Psychology.

N. S. N. Sastry, Bangalore.

1. Honesty Index.

The necessity of depending upon the honesty of testees, in the several psychological tests, makes it imperative to have a dependable measure of the testee's honesty: The paper desribes an attempt to measure honesty with the help of two honesty tests.

The index and the coefficient of correlation has been worked out on the basis of of the scores in the two tests. The index of honesty is indicated by the formula;

$$\text{H. I.} = \quad \times \frac{r}{x}$$

where s = Total score that a testee gets,

n = Total number of cases,

r = No. of successful performances,

x = No. of crucial cases.

2. Sex Differences in Inductive Reasoning During Early Adolescence.

M. M. Shukla, Baroda.

An investigation to study inductive reasoning in children of ages 12, 13 and 14 was carried out in the town of Maldon in the county of Essex in England. A group test of inductive reasoning was constructed for the purpose and was administered to children of both the sexes in Secondary Modern and Grammar Schools in the town.

On comparing the performance of boys with that of girls, the latter were found to be superior at all the three age-levels under investigation. The differences between the mean performances of boys and girls at the ages 12 and 13 were not found statistically significant. At the age of 14, however, the difference between the mean scores of boys and girls was found to be statistically significant at .5 per cent level. When the mean scores of boys and girls for the entire age-range (12-14) were compared, the gain in favour of the girls was again found statistically significant at 5 per cent level.

The results obtained in this investigation are thus in harmony with the general findings of Burt and other workers in the field of intelligence testing, the intellectual superiority of girls over boys during early adolescence.

3. "The Reliability of Personality Questionnaires".

S. Jalota, Jamshedpur.

The questionnaire method can magnify the field of exploration to an almost unlimited extent. The limits being set by the horizons of literacy. "Gallup-polls" and 'Straw'

surveys are being conducted in India nowadays so the importance of our problem is only a reflection of current interest.

There are two criteria of the reliability of a test, the internal and the external. I have written about the former elsewhere. Here I discuss the latter that is comparison with the actual observations during a re-test.

Out of about 1000 candidates tested for selection, 20 were cases of re-test. In one personality questionnaire there were six questions; two of which referred to the subjective or emotional aspects, the rest referred to the objective situation or habitual modes of knowing and acting. The answers in the retest, were scored as 'Substantially the same' or as 'different'. The frequency of the similar answers were as follows:—

No. of similar answers	1	2	3	4	5	6
Frequency	3	3	4	5	4	1

Further, the similar answers for (*a*) the total = 53.66%

(*b*) objective questions = 66.25%

(*c*) subjective questions = 37.5%

(d) either of the two subjective questions = 10%

Results:

(*a*) The reliability of personality questionnaires is generally low.

(*b*) it depends upon the proportion of questions that probe the subjective or objective or objective aspects of the candidate.

(*c*) the direct subjective questions usually do not get reliable answers.

4. The Value of Differentiating between the Concepts of Growth and Development as applied to Psychology and Education.

(Miss) J. F. Forester, Madras.

Although "growth" and "development" are frequently used to denote different aspects of change in the processes of physical maturation, they have been for the most part used interchangably in psychology.

The distinction in the physical aspects is between increase in size and increase in complexity.

The thesis of this paper is that there is value in carrying over the distinction in these concepts to psychology, "growth" standing for simple increase, practice and consolidation, and "development" standing for the emergence of something new, the co-ordination of existing elements into new patterns, a new relevant context etc.

Growth and development, although distinguishable, are intimately interrelated and can be observed both in phylogenetic responses and in the processes of learning which are the basis of education. Growth lays the foundation for further development, and development provides the context within which growth must work. Growth satisfies the need for security, development the need for adventure.

Discussion of various problems of interrelatedness, *e.g.*, rates of growth and development and their influence on each other. The concept of maturation and 'readiness' for development or learning; its importance in curriculum planning in relation to the optimum time to introduce certain subjects and topics.

5. *Mental Survey of a Village.*

C. M. BHATIA, Allahabad.

It is a report of individual mental testing, with the help of a Battery of Performance Tests of Intelligence of all the illiterate boys of a typical U.P., village. The final table of the mental ages and the I.Q's. of the boys are given, and some particular cases are discussed from the point of view of educational guidance. The Battery of Performance Tests, which contains as sub-tests,

(i) A adaptation of Koh's Block Design Test.

(ii) A adaptation of Passalong Test.

(iii) A specially constructed Pattern Drawing Test.

(iv) A specially constructed Immediate Memory Test.

& (v) A specially constructed Picture constructions Test has been constructed and standardised by the author for literate and illiterate boys between the ages of 11 to 16 years.

6. The Construction of a group attainment test of Hindi.

(MRS.) KAMLA MEHROTRA, Allahabad.

The construction of the test has been taken up in view of the growing importance of Hindi which is being introduced throughout the Province as a compulsory language upto the Higher Secondary Stage.

On the basis of an analysis of the various objectives of the teaching of language, items testing the following have meen included in the test:-

(1) Comprehension of written matter in prose and verse.
(2) Vocabulary.
(3) Knowledge of Grammar.
(4) Spelling of words.
(5) Common idioms, phrases and proverbs.
(6) Appreciation in poetry and
(7) Composition.

For the initial try-out two forms of 100 questions each have been prepared. After the try-out, about half the present total number of questions will be selected according to their difficulty value. Thus the final test will have about 100 questions covering the above aspects of linguistic ability.

The prose passages and other materials included in the test are from the environment of the testees. The poems of well known poets have been selected both from the ancient and the modern period.

7. Group Verbal Test of Attainment in History for class IX.

(MRS.) KIRTI DEVI SETH, Allahabad.

The existing examinations being subjective are liable to errors of personal judgment in measuring the achievement of the pupils in various subjects. Here an effort is made to devise an accurate objective achievement test to do away with this main defect. The criteria taken into consideration in order to make the test an accurate measuring instrument are, firstly its validity it must measure what

it aims at measuring; secondly, its reliability the consistency of the test and thirdly, its usability, the test must be usable.

A detailed study of the curriculum of history for class IX is done before the construction of the test. The minimum period covered in almost every school in class IX has been taken up as the contents of the syllabus. The information as far as class VIII on the subject has been asked only as a connecting link and not as the main subject. Further, such items as present a complete view of historical facts have been selected.

The questions have been so framed as to call-into play such psychological factors as memory, reasoning, imagination and visual imagery.

For the try out purpose the test will be administered on about 150 subjects in four institutions. The two forms of the test will be administered in an interval of seven days.

Then the validity of the test and the difficulty value of items shall be found out and on this basis the items will be selected for the final draft.

8. An analysis of the returns of a specially prepared personality inventory from one thousand educated Bengalee youths.

NILADRIPATI BOSE and GORACHAND KUNDU, Calcutta.

A personality inventory of 45 questions was used in connection with the selection tests for candidates applying for admission in the Calcutta Medical College and the Campbell Medical College, 1948. The present paper is based on the analysis of the records of one thousand applicants who were all Bengalee boys having passed the Intermediate Examination in Science. The analysis shows interesting findings about temperamental qualities.

9. A Preliminary Report on construction of an Attainment Test in General Science for class VIII of U.P. Schools.

GURU MAUJ PRAKASH, Allahabad.

For constructing the test, first the main objectives of the teaching of General Science were noted. The main ones are the acquisition of:—scientific facts and vocabulary; the ability to apply the general scientific principles to the facts and phenomena of the laboratory and nature; skill in manipulating the apparatus used in scientific experimentation; and scientific observation and attitudes of impartiality and critical thinking. Of these the attitudes and the manipulative skill could not be included in the test for obvious reasons. Emphasis is laid on the testing of the ability to apply the facts and principles of science and not on memoritor learning.

The test consists of two forms with 150 items each. They cover the prescribed course. Each form has five sections as follows:-

Section I. Alternate response items (25)

Section II. Multiple choice items (30)
These questions involve application of principles and grasp of concepts.

Section III. Question on diagrams (45)
These are based on mechanical ingenuity knowledge of appratus and experiments and structure of complex machinary and organism.

Section IV. Completion and simple recall items (30)

Section V. Matching items (20)

Frequent use of diagrams has been made, and facts and phenomena from children's environment are included.

10. "Studying Social Relationships Among Children—A Survey of Techniques and an Illustrative study of Inter-personal Relations in a Group of about fourteen year old Boys."

J. K. SHUKLA, Baroda.

The recent findings of social research have emphasised the importance of studying the general development of the social behaviour of children with particular reference to the study of inter-personal relations, social acceptance and rejection. The present paper is intended to give a brief explanation of the term 'social relationship' and the related concepts used in present-day psychology and emphasises the need of investigating the complex process of social maturation of school children.

For this purpose a general review of some of the methods employed in various studies is undertaken. Diaries, and Personal records, Time-sampling, Verbal-choice, Paired comparison, and Experimental techniques etc., are considered and a detailed account of the present-day Sociometric method as used by Moreno is given. Explanation is offered of the typical Sociometric test, its characteristics, and of the techniques for graphical presentation of sociometric data, as also of the relevant statistical considerations involved. The value to education of the Sociometric method is then briefly considered.

Finally an investigation undertaken to demonstrate the use of this technique for analysing the inter-personal relationships in a class of about fourteen year old boys is reported and suggestions are offered for possible scope of research in this direction. A short bibliography is given at the end.

11. The singnificance of *analogy items* in the 'omnibus' type of group intelligence tests.

S. K. BOSE, Calcutta.

The correlation of the scores on the analogy items only with those on the whole set of items in the verbal intelligence tests used by the S. P. Directorate during World War II, was worked out by the present writer in collaboration with his colleague in the War Department, Dr. K. G. Rama Rao. One thousand records were examined at that time. With the assistance of a postgraduate students, Sreemati Maya Guha, the records of one thousand candidates seeking admission in the Calcutta Medical College have now been examined. They were given a specially constructed test of intelligence comprising sixty items of which eleven were analogy ones. High positive correlation has been obtained.

The paper also presents a theoretical discussion on the importance of the capacity for seeing analogous relationship as a constituent of what is known as intelligence.

12. Perseverative Tendency in Mental Set.

K. C. MUKHERJI, and A. ROY, Calcutta.

The effects of perseverative tendency in different mental sets are shown in this paper.

13. "The Concept of 'Set' in Modern Psychology".

DAMODAR MISRA, Patna.

The concepts of "Set" has been the basic notion in Modern Dynamic Psychology. The theoretical position of Modern Psychology is no longer mechanistic. The more

recent trend of development is towards treating Psychology as a "Science of Behaviour" and such a Science is not necessarily mechanistic or Behaviouristic.

The attempt here has been to show by integrating the results of studies that determination of behaviour by the 'intervening variables' is an established fact and that a "Science of Behaviour" cannot do without the motion of the "Set" or the "Einstellung". The "Einstellung" facilitates and also inhibits behaviour.

The Historical Development of this concept has been traced and certain experimental results have been cited. The new development in psyochologising that it is not only the fundamental prepotent biological needs which constitute the drives, habits and modes of reaction acquired may also have equally driving force. Woodworth's doctrine embodied in his "Mechanisms become drives" and Allport's concept of "Functional Autonomy" are incorporated.

The final position taken is that with these new developments Psychology, as a Science, can no longer afford to be mechanistic and that a psychological consideration of behaviour will be incomplete and inadequate if it does not include an account of these "intervening variables".

14. A note upon the Statistical Aspects of the Omnibus-type Verbal Test No. GIT-013.

S. JALOTA, Jamshedpur.

The test contains 92 items, consisting of Number-Series, Analogies, Vocabulary (Synonyms-antonyms), Instruction, Best Answers, Classification and Verbal Reasoning or Sentence completion). The Instructions and some numerical items were given in the *inventive* form, while all the rest were put in the *Selective* form.

The following results were obtained from 237 candidates who appeared during December, 1947 to July, 1948 for Selection Tests in the Tata Iron & Steel Co. Ltd., Jamshedpur.

Mean = 52.82 S. D. = 17.64

Range = 8.87 Relative skewness or B_1 = —.305

Relative Kurtossis or B_2 = + 2.19

The coefficient of Reliability as measured by correlating the correct scores of the ODD and EVEN items is +.927. With the application of the Spearman-Brown prophecy formula the figure of reliability goes up to +.962 with a standard Error of. 0061.

15. Construction of a Group-Attaiment-Test in English.

KANTI CHANDRA PANDEY, Allahabad.

A group test is devised for measuring the attainment in English for the boys and girls reading in 8th class in the schools of U. P. The criteria for the choice of items in the test are those objectives of teaching English which lend themselves to objective testing. In general, they test the ability to read and understand English and to detect common faults in the written language; the acquisition of familiarity with certain common rules of grammar and punctuation; and the acquisition of proper vocabulary. The following classes of questions have been included:—

1. Reading and comprehension of prose and verse.
2. Vocabulary.
3. Appropriate words and phrases.
4. Synonyms and antonyms.

5. Idioms and phrases.
6. Detecting faults in words and sentences.
7. Questions on grammar.
8. Questions on punctuation.
9. Questions on spelling.
10. Questions on rhythm.
11. Questions on the use of articles.

The test-techniques mostly employed are completion and multiple choice.

16. *A Critical Study of Kohs Block Design Test.*

D. D. TEWARI, Allahabad.

The main problem studied is the claim of Kohs with regard to Blocks Design Test for discrimination of higher levels of intelligence. Kohs makes a very high claim in this respect. In order to arrive at some tentative conclusions, the Allahabad Intelligence Tests for 11 by Dr. Sohan Lal was also administered to the subjects.

The results of the two tests are discussed in full and in the end conclusions are stated with regard to the main problem.

Method adopted for administering the test:

The coloured cubes are shown to the subject and it is explained that all of them are identically coloured. It is fully ascertained that the subject can identify each colour separately. Then the subject is told that with these blocks he has to prepare certain designs which would be presented to him. Then a trial design is presented by the experimenter. The subject is not told the time limits in order to avoid excitement. The time however is noted by the experimenter. Although in administering and scoring the test the counting of moves is also important, but as it involves a somewhat complicated task of combining two variables, it has been abandoned and time alone is taken account of in determining success of failure.

17. Mental Survey of two Villages in U.P.

GURU MAUJ PRAKASH, Allahabad.

A survey of Intelligence of illiterate boys between 11 to 16 years in age was carried out. The villages selected for this purpose were Biashanpur Bindwallia and Mathauli both lying in Tehsil Padrauna of District Deoria in the United Provinces. Bhatia's Battery of Performance Test was employed.

The investigation revealed that the illiterate boys in these villages had I. Qs ranging from 55 to 110, two having capacity to benefit from higher studies and six by education upto Senior Basic stage. One case of mental defficiency was detected.

Inter-correlations between the tests of the Battery for the 34 cases were found to range from .35 to .67. Three main problems were usually met with in village testing *viz.*, the problem of ascertaining the age of the boys, the presence of curious villagers round the place of testing, and the suspicious attitude of the villagers towards the test.

18. A Psychological Study of the Physical Efficiency Tests.

R. N. TRIPATHI, Allahabad.

(1) The nature and the fundamentals of these tests as prepared by the Council of Physical Education, U. P. for being prescribed in the Basic and the Secondary Schools of U.P.
(2) The aim and objectives behind these Physical Testings.
(3) The problem of their standardisation and adaptability.
(4) The problem of the suitability of these tests in relation to the special and peculiar Indian conditions (Analysed and discussed in fuller details.)

19. Construction of an "Intellegence Test" for 12 plus in Urdu.

A. W. B. Qadri, Allahabad.

Two sets of questions are framed. Each contains 150 questions and classification is the same in both the sets. They contain the questions under the following heads:— (1) Direction Test (2) Classification (3) Analogies (4) Same and opposite (5) Mental Arithmetic (6) Code reading (7) Proverbs (8) Mixed sentences (9) Best answers (10) Essentials.

These tests are administered to the students of the requisite age in the Anglo-Hindustani Institution. It is taken into consideration that the initial try-out is given to a fully representative group of students. With this object in view the students from different types of institutions-such as Govt. institutions, aided institutions, institutions run by the Municipal Board (that is, vernacular Middle School of yesterday, are taken. The districts selected for try-out purposes are Allahabad and Budaun (a district in Rohail-Khan division). These places are selected not simply on the grounds of convenience but for being 'models' in certain respects. Allahabad being the centre of the provincial educational activity, is certainly ahead of other districts in the field of education. Badaun is a seat of learing so far as Urdu is concerned and the students are believed to posses a better knowledge of the language than those in the other districts. But being a small district has not attracted the full attention of the Government, and the education is not being imparted in a perfect manner. In this way the two districts present extremes to a great extent.

After drawing out the 'difficulty error', 50% of the questions are dropped and the final test contains 150 questions with a time limit of 45 minutes.

20. The Construction of a Verbal Group Intelligence Test for Boys and Girls of 12 years in the Schools of the United Provinces.

Guru Mauj Prakash, Allahabad.

As a step towards the satisfaction of the need of proper and sufficient 'Tools for Educational Research' the problem has been taken up. The Test contains two forms of about 150 questions each. The items selected are multiple choice and complection types of classification, analysis, essentials, number series, substitution, space relations, incomplete sentences, obeying directions, anologies, reasoning and absurdities. The criterion for choice of items was their correlation with. Alphabet matrices have been used in obeying direction items. In anology items a simple verval method has been used and not the mathematical notation of proportionality. Special care has been taken to make the language easy and the contents interesting. .....

After a try-out in schools of Allahabad the final test will contain two equivalent forms with 100 questions each.

II. Abnormal Psychology

21. Mental Cases under Family Care.

K. D. Ghose, Calcutta.

This is an experimental study of four mental cases that did not respond to treatment in Mental Hospitals and were put under the supervision of sympathetic families—one under that of the patient's own family and the other three in foster

homes. This technique of placing patients in carefully selected homes has yielded very satisfactory results as in the Unted Staes of America, Canada and Switzerland. Mental experts have now turned to this new technique. The general mode of treatment and supervision in selected homes. Sympathetic handling and gradual adjustment to life in general. Patients gradually feeling an inclination for simple types of work and becoming fairly useful men and women in society. Difficulties, the question of expenses and the great reluctance of Indian families to have patients.

22. New Trends in Psycho-analysis: A Critique of Freud.

M. M. Shukla, Baroda.

Recent developments in psychology do not lend support to some of the Freudian assumptions re: the origin and treatment of neuroses. Though some of the doctrines of Freud, *e.g.*, the strict determination of psychic processes, unconscious motivation, etc. seem to have been fairly established, his teachings re: the nature of man and society are positively misleading.

An attempt is made in this paper to show how Freud's conception of human nature is essentially a reflection of the XIX century philosophy, economics, anthropology, neurology, etc., and how it shares their limitations. Freud's exclusively biological orientation led him to neglect the cultural factors in the causation of neuroses, and to mistake the peculiar drives of modern man as his original nature. It also led him to underestimate the therapeutic possibilities of a properly controlled environment, both mental and material.

Finally, a new orientation of psycho-analysis in the light of recent findings of psychology is presented, and the new possibilities of treatment are suggested.

23. Study of a Case of dual-Personality.

Udai Bhanu, Indore.

A women of 32 was attacked by a ghost. She was kept under observation for six months.

During the attack she breathed heavily and quickly, nodded her head, did not love her child, experienced illusions, and behaved in every way as if her own personality was totally depressed.

The ghost showed her name. She promised several times to go away and leave the patient alone but her promise was never fulfilled.

The following conclusions are drawn:-

I. Some persons develop a mental state which depresses the personality of the self.

II. From the data collected it is difficult to accept the existence of another entity as true.

III. The fixation of the ghost was so deep in her mind that she (ghost) was regarded as the only cause of all the physical ailments from which she suffered from time to time. In other words we can say that the fixation of an idea affects the finding of causes.

IV. There is a state of fixation which cannot be removed by analysis, distraction, fear, pain and devotion.

III. Educational Psychology.

24. Perseveration and Teaching Ability.

T. K. N. Menon and S. C. Parikh, Baroda.

The present inquiry was instituted to find out whether perseveration helps, hinders or has no relation to teaching ability, and if there is any functional relationship between the two, to find out to what extent the relationship exists.

(*a*) Preliminary investigation: The subjects chosen were 43 graduate teachers undergoing professional training. The subjects were given the 'IT' test, their perseveration scores were determined the coefficients of correlation between

(*i*) perseveration scores and internal marks and

(*ii*) perseveration scores and marks given by external examiners were determined. The analysis of the data resulted in the following conclusions.

(1) Individuals vary considerably with regard to 'perseveration', some are high perseverators, some are moderately high perseverators, some are moderately low perseverators, some are low perseverators.

(2) There is a negative correlation between "perseveration" and 'teaching ability' as judged by 'internal marking' or 'assessment by external examiners'.

(*b*) Final investigation: The subjects chosen were 70 graduate teachers and 20 undergraduate teachers undergoing professional training. The subjects were given

(*i*) the 'I.T' test

(*ii*) Reverse stroke test

(*iii*) Alphabets test

(*iv*) Aitches test.

The perseveration scores were determined and these were compared with the valuation of teaching ability given by a Committee of Masters of Methods. The results of the final experiment confirmed the conclusions of the pre preliminary one.

25. Assessment of Interest in Medical Science among Applicants for Admission to the Medical Colleges of Calcutta.

Gorachand Kundu, Calcutta.

A short questionnaire enquiring why the applicant is keen to join the Medical Colleges, what profession he will choose if he fail to get into medical line, etc., was given to about 1250 applicants. They were also required to show the extent of their commonplace knowledge of medicine and hygiene by answering 16 questions on the subject. The answers of 1000 applicants have been scrutinised.

26. A Study of Errors in English.

Miss. Sushila Varma, Allahabad.

The aim of the investigation is to find out the common errors of children and to examine their nature and their psychological causes. The second and most

important aim is to devise some methods based on sound principles of psychology, to root out such errors in English.

The exercise books of children were collected from different schools and different classes in each school. The exercise books of children from class third to tenth were examined.

An attempt has been made to compare errors of children in Indian schools with those of English schools. These errors have been classified into significant types and remedial measures have been suggested based on the phychological analysis of the types of errors.

27. A Psychological Study of the Working of the Basic Scheme in Allahabad University 1947-48.

S. P. S. CHAUHAN, Allahabad.

The working of the scheme of Basic National Education in 25 Basic schools (rural) in Allahabad District was studied. On examination it was found that the children who were taught in a basic way, appeared to possess intelligent thinking and a broader outlook.

This paper deals with the psychological study of the working of the scheme and goes to prove that the Basic Education is based on a sound psychological foundation. Children overflow with instinctive energy and this education provides outlets, through crafts, which are of great value to the individual and society. Manual work too helps in gratifying the creative desires which directly helps the growth of individuality. Transfer of Training is more facilitated when a child learns in a basic way rather than through Books. A few constructive suggestions have been added to make the Basic Scheme more perfect.

28. Reading Interests and Habits of Girls.

(MISS.) M. GHOSH, Allahabad.

The object of this investigation is to find out with the help of questionnaire, what kind of books beside the text books (prescribed) in Hindi, they read at home, what kind of books are available to them for their outside reading, either from the School library or their parents purchase for their Supplementary reading. The attempt is to find out their likes and dislikes in reading the kinds of books they are interested to read, the type of contents which interest them most.

While giving the questionnaire, to be answered by the girls, the girls were told that this is not an examination but an enquiry, which help the teachers, heads of institutions, parents and guardians in choosing better reading material for them, and also to help the authorised publishers know, what the girls like to read, what they do not like to read.

The questionnaire is in Hindi, and consists of eighteen questions, some of them including parts.

The questionnaire is meant for IX and X classes of four secondary institutions (girls) at Allahabad. The total number of girls tested is about 200.

The answers to questions have been analysed and conclusions drawn.

29. A study of Reasons for the Dismissal of Teachers in Secondary School.

L. J. BHATT, Baroda.

Teaching profession looks for certain desirable traits in the teachers who are employed. The absence of some of these traits give rise to conflict between the employers,

and the employees, and subsequent dismissal of the teachers. The reasons for such dismissals were elicited from the employers, classified into statements (Table I and Table II) and the following conclusions arrived at: (1) those dismissed lacked qualities of leadership, (2) those dismissed displayed unbecoming conduct, (2) they failed to co-operate, (4) they were not able to adjust, (5) they were not industrious and (6) some mismanaged financial side of the work. etc.

30. A study of Teachers as depicted by Charles Dickens.

L. J. BHATT, Baroda.

Teaching efficiency does not readily submit to analysis. The researches relating to qualities essential for success in teaching have among others worked upon: (1) compilation of pupils' opinion, (2) summarizing of expert opinions. The practical school-men and others interested in the education of their children are consulted as experts.

Psychologists have made a study of children in Charles Dickens. There is a scope for a similar study re: Teachers in Charles Dickens. His novels like Nicholas Nickleby, Old Curiosity Shop, David Copperfield and others give pictures of teachers Dickens liked most and teachers Dickens liked least. The paper gives an analysis of Dickens' opinion which would prove useful to all engaged on the problem of measurement of teaching efficiency.

31. A Study of Adult Education in Allahabad.

MAJID HUSAIN SIDDIQI, Allahabad.

I had two considerations in my mind when I chose "Adult Education in Allahabad" as the topic of my paper. The first was that future of India is linked up with the progress of adult education.

The second was that Allahabad, being the centre of all educational activities, will serve as a model to the work done in the field of adult education.

I handled this problem by emphasising the need of adult education in independent India from the political, social, educational and philosophical point of view. Then a brief review of the work done in this field in U. P. was made to serve as a background to the actual study of adult education in Allahabad.

In studying the various institutions and schools for adults I took special care to examine their organisation curriculum and the method of teaching. My main task is to apply the Psychological principles to the adult education and to give some constructive suggestions.

32. An Inquiry into the Performance of Graduates Under Training.

L. J. BHATT, & A. S. PATEL, Baroda.

It is apparent that intensive study of curriculum problems directly related to the education of teachers should be taken up seriously on a nation-wide scale. Usually the B.T., L.T., or B.Ed. Courses cover two aspects of a teacher's education—the practical professional training and the theoretical professional training. The paper under report makes a study of ten groups of Graduates who appeared for the B.T. degree examination in the preceding ten years from the year 1939 owwards. Their achivement in terms of University marks in theory and practice is analysed and coefficients of correlation are worked out to establish the influence of theory of education on the practical teaching ability.

It is clear that a knowledge of theory of education considerably helps a teacher in his practical class-room teaching, as can be noted from the positive coefficients of correlation. Reasons for those cases where correlations are not comparatively significant are also studied in the paper.

33. A study into the General Physical Standard of Students entering Allahabad University 1947-48.

JAGDISH RAM MEHTA, Allahabad.

The recent findings of physiological psychologits have thrown much light upon body mind relationship. The educational implications of this relationship has however now been grasped. In our inquiry we have two things in view, firstly, to gauge physical standard of health already attained by our young men entering Allahabad University and secondly to find how far our health medical service and Physical Department work in coordination and close co-operation as to prove effictively helpful for the scholars to achieve desirable health standard.

The basis of our enquiry is a Medical Health Report 1947-48, comprising 697 cases who duly medically tested by our medical officer. The necessary data in (1) Height (2) weight (3) Chest measurement (4) regarding vision (5) General diseases was gathered from the Medical Report. We then come to the following finding by statistical calculation.

	Gereral Scholars.	Hindus.	Muslims.	Sikhs.
	No. 697	600	55	42
(*a*) Mean Height inches. ..	66.24	66.03	66.89	66.21
(*b*) Standard Devitation. ..	2.727	2.748	2.57	2.602
(*b*) Mean Weight, in pounds. ..	130.54	120.24	116.06	131.98
(*b*) S. D.	16.211	19.495	17.91	14.24.
(*a*) Mean Chest.	33.186	32.87	32.87	33.74.
(*b*) S. D.	2.376	2.204	2.19	2.058.

The above statistical work has been graphically illustrated and coefficiets of correlation between height and weight H have been established which are as followsff—

	Hindus.	Muslimas	Sikhs.
Coefficient of correlation H|W.	0.553	0.36	0.297.
Probable Error.	0.017	0.079	0.093.

34. Physical Education and National Health.

VED PARKASH BANSAL, Allahabad.

The conditions of modern civilization, with its crowded localities, confined places and sedentary occupations the increasing need for study and mental application, the many social and psychological difficulties of everyday life, the war and its after-effects, shortage of food grains, the unwholesome and unnutritious food, regular and steady elimination of ghee and milk and instead Dalda and Kotogem ever coming strong upon our diet, have all restricted opportunities for natural physical growth. However, there is one panacea for all these evils and that is physical education. It is therefore necessary to evolve a nation-wide programme of physical education, which will be physically wholesome mentally stimulating and socially sound.

Now that India has achieved independence she may have to defend herself not in the distant future but perhaps in the immediate present and it is the might of the Indian

Union as manifested in her capacity to fight in the battle-field that will determine India's place in the comity of nations. For that India has to raise and reorganize her forces. Young and healthy citizens are needed both in the military and in the homes and yet all this is possible only through an organized programme of physical education.

35. *Working of the Montessori System of Education in India.*

(Mrs.) B. De, Allahabad.

Revolution in political, social and economic field accompanied by inventions and achievements of Science created a new attitude in all aspects of life and hence a reaction followed against the old theory and practice of education which resulted in efforts individual or otherwise, particularly in Germany, Italy and America. This reaction got support and strength from psychology and experimental work. The efforts of Maria Montessori were an event in this general revolutionary set-up. The central feature of her method which originally had medical importance, is sense-training and development of personality through playway and with the help of her didactic materials. It is a clear and remarkable advance in the field of education. But in India old education still persists, and the efforts for new education suffer from a very big gap, *i.e.*, there is no provision in any scheme for educating children of pre-school age. It would be my effort to indicate how the Montessori method has been worked out in India specialy in U.P. and how improvements can be effected in this field according to Indian conditions.

IV. Vocational Psychology.

36. A report on the testing of intellingence and special abilities of a group of Railway workers.

(Miss.) Usha Bhattacharyya, Calcutta.

A group of one hundred unskilled and semi-skilled Railway workers were examined in the Chitpore and Barrachpore yards near Calcutta. Non-verbal intelligence tests and mechanical ability tests were given and every individual was interviewed to find out how far placement was made in accordance with the qualities as indicated by the psychological examination.

37. Fatigue—Tests in Industry—A Report.

Kali Prasad and Hari Shanker Dubey, Lucknow.

The present paper describes an investigation into 'Industrial Fatigue' in a textile mill. It is proposed to see if it is possible to use relevant psychological tests to confirm the findings of output-data.

The investigation has been carried out in relation to two sets of data:

1. The hourly output records arranged to show variations in rate of work for consecutive days of the week and for a composite working day.

2. The results of steadiness and disc-dotting (a modified version of Mc Dougall's Three-hole disc-dotting test) tests administered to a sample of workers in the factory situation at three different stages of the day *i.e.*, before the work, in the interval and after the work.

The experiment shows that:

1. There is a progressive deterioration in work in all the shifts and sections. The curve of night work shows steeper decline in the second spell.

2. The deterioration in output is accompanied by a progressive depression and unpleasant 'feeling tone' among the workers.

3. Corresponding to the above changed there is a gradual weakening of attentive capacity, muscular unsteadiness and visual-motor incoordination.

38. An Experiment in the Introduction of the Rest Periods in the Working Spells and Their Influence in the Productive Capicity of the Workers in the Weaving Factory and Their Health.

DEVENDRANATH L. AMIN, Mysore.

The paper reports the influence of the rest period in the working spells on the health and the efficiency of the workers. The study is intensive and the experiment is extended over approximately a period of six months, (Nov. 1917 to May 1918) with eight workers. The result shows that when the rest pause of seven minutes at 9-30 A.M. in the morning spell and another rest pause of fifteen minutes at 2. P.M. in the afternoon spell (When the factory is working between 7 A.M. and 3-45 P.M. with an interval of 45 minutes at 11 A.M. are administered, they are conducive to the health and efficiency of the workers. It also describes the method of determining the nature, the location, and the duration of the rest periods. The statistical results show that though there was a loss of 3.5% in time in eight hours of work, still an increase in efficiency by 2.5% on the whole was noted as compared with the previous out-put records. The rest pauses also indicated favourable variation in absenteeism, sickness records, etc. However it is desirable to carry on such an experiment in different factories differing in the nature of work and showing variations in the climatic conditions etc. to study the effects of rest periods on accidents, labour turn-over, efficiency and absenteeism and further to analyse whether the influence of the rest, peside persist even after they become routine in nature.

39. Injury to the Mind in Industry.

N. S. N. SASTRY, Bangalore.

Occupational hazards are many and they naturally call for immediate remedy. Many such hazards are usually connected with the danger of physical injury. There is another kind of hazard which is equally, if not more, dangerous. This is mental injury. An individual who is thus injured might develop a neurosis. The neurosis might be developed before the injury actually takes place, or during injury, or after injury. At the present time many methods are employed to meet these situations and often to prevent such occurences. But there is an urgent need for more effective measures and methods to be employed. Sometimes, injury to the mind can cause more danger than injury to the body.

40. A Short Survey of the Intelligence, Attitude and home-life of a group of women unskilled labourers.

(MISSES) BANI SARKAR, MAYA GUHA and UMA BHATTACHARYA, Calcutta.

With the kind permission of the TISCO authorities the survey was undertaken in May and June, 1948. One hundred and five women workers of the Tata Works at Jamshedpur were given the tests and also interviewed. Homes of some of them were visited. Attempt has been made to find the relation, if any, between intelligence and attitudes towards work and life in general.

41. Prediction of Accident Proneness amongst Industrial Workers by Psychological Tests.

ASIM KUMAR PAL, Calcutta.

Facilities were kindly provided by the Chief Psychologist of TISCO to study the incidence and factors of accident among the workers in the Sheet Mill at Jamshedpur. 150 workers selected for the purpose of investigation were wiven a battery of intelligence tests as also other psychological tests. Intercorrelation of the tests as well as correlation of frequencies of accidents with the test scores have been worked out. Prediction of accident proneness has been attempted on the basis of test results. A few suggestions regarding remedial measures have been made.

42. Selection of Tram drivers.

(MISS) KANAK MAZUMDER, Calcutta.

The paper presents a preliminary report on some of the findings of an enquiry into the problem of detecting accident prone tram drivers in Calcutta. The work has been spons red by the Indian Research Fund Association and is being carried out under the guidance of Sri S. K. Bose. Arangements have been made by the Calcutta Tramways Company for testing the driver trainees at their training school at Tollygunj Tram Depot and at the laboratory of psychology, Calcutta University. Every facility has been given by Prof. G. Bose, Head of the department of psychology, for carrying on the testing in the laboratory and outside. The driver-trainees are ranked as 'good', 'doubtful' and 'bad' on the results of psychological tests, and their progress during training period are noted. The career of those appointed by the Company to drive tram cars on the streets of Calcutta are being followed up.

43. An experiment in the selection of the weavers on the basis of their Manual Dexterity and further standarisation of the weaver's tests.

DEVENDRANATH L. AMIN, M.A. Mysore.

The paper reports how the tests were devised for the measurement of the skill of the weavers in the Weaving Department. The reliability of these tests is determined with 40 workers. The tests are validated by internal certerion of the supervisor's estimates and external creterion of the productive capcity of the workers. The number of workers tested for validating the tests is 40. A follow up was carried out with reference to 15 workers who were employed after testing to check the validity of the tests. The tests are fairly diagnostic and adequate measure of manual dexterity of the weavers.

44. An enquiry into the subjective effect of using ear-plugs by workers and supervisors in noisy places.

By PROMADANATH CHOBEY, Calcutta.

The enquiry was conducted in the foundry of the Tata Works at Jamshedpur through the courtsey of the authorities. The workers and their supervisors. 23 in all, were given the ear-plugs for about a fortnight. Their experiences and observation were noted in details. On the whole the use of ear-plugs gave a sense of relief and satisfaction.

V. Introspective Abnormal Psychology.

45. 'Resonse Psychology and Gandhijee'.

Srimant Lal Das,

The author has been practising 'Sharanagati' more or less for a quarter of a century now. A short *description* of three 'miracles of Sharanagati' has been given. From Sharanagati he was unconsciously led to the investigation of Response Phenomena' in general.

Three clear ideas, namely the following, dawned on him in due course:— the response of the external world; the response of the inner world; and the Response Psychology.

A brief summary of Response Psychology with special reference to religion, is given followed by choice quotations from the speeches and writings of Gandhiji to show some of the facts of this aspect of mind.

The paper also throws some light on 'the inscrutable ways of the Mahatma.'

VI. Curriculum Construction.

46. Music in Basic Education and Psychology.

(Mrs.) Bani Chatterji, Calcutta.

The spread of basic education among the general illiterate masses in the country is one of the major problems that confront us to-day. For the purpose of the proper conduct, which should incidentally make for better citizenship too, we may well press Psychology into service.

Assuredly fruitful work is being done in Psychology. However, to facilitate and advance it even further, yet other useful sources of information must needs be tapped. Music, it would appear, has much in common with Psychology. As I have pointed out earlier in my articles on the subject (*vide* Proc. Ind. Sc. Congress, 1943 and 1944 and my lecture on "Music and Diversional therapy" delivered on the 31st May, 1945 before the Royal Asiatic Society of Bengal), music and psychology are, in their nature, close allies pursuing a common object, "the attainment of a fully sublimated psyche' free from repressions and inhibitions". Their corner-stone is the human mind; and mind's ascent to self, or spiritual realisation and from this to the yet higher realisation of Divinity, is the common goal and highest aspiration. Music should benefit psychology for the child's natural propensity for music is only too well-known.

In view of all this we may rightly claim that music has, as is unversally recognised in the West, a definite educational value, and a place in the prosecution and promotion of Psychological studies. A team work of Psychology and Music should, therefore, ensure success to the Government of India's plan of "Universal Compulsory Basic Education".

VII Genetic Psychology

47. Integral Education.

J. M. Sen, Calcutta.

In one sense the responsibility of the educator exceeds that of the physician. The physician, as a rule, has to deal with mental formations already fixed and will find in the already developed individuality of the patient a boundary already established for

his activity and also a sort of a security for the patient's independence. The educator, however works on plastic material which is sensitive to every impression and he must observe the duty of not moulding the young mental life according to his own personal ideals but rather according to his dispositions and possibilities inherent in the object.

Children ought to be educated not for the present, but for a possibly improved condition of man in the future, that is in a manner which is adapted to the *idea of humanity* and the whole destiny of man. Parents usually educate their children merely in such a manner that, however, bad the world may be, they may adapt themselves to its present conditions. But they ought to give them an education so much better than this, that a better condition of things may thereby be brought about in future. The view that regards the ego as a fighting force implies that education is a process of acquiring freedom—the freedom of helpful service it may be, but still freedom.

It is obvious that an important part of the work of education must be to make the pupil aware of the nature of his environment. Clearly it is not a matter of mere information. Knowledge according to the nurture theory is valuable for its own sake, when it is valuable at all. But there are many pieces of information about the environment that are in themselves worthless. The knowledge that counts, the knowledge that is power, is not mere acquaintance with facts in their relation to each other. Knowledge must consist of signifiant facts, facts that mean something to the knower, and can be applied by him in some way advantageous to himself or to others. The human being's powers of assimilating knowledge being ludicrously inadequate in view of the vast domain that is available, it is obviously necessary to limit the range. In this process, however, there is danger of introducing scrappiness. On what principle are we to decide what is to be taken and what left out?

So fundamental is this problem that certain educators have set about developing a complete scheme of education the main function of which is to maintain the unity of mental life, and obviate the danger of a completed scheme resulting in a thing of shreds and patches. Those who adopt this ideal of what they call *Integral Education* fall back upon the authority of Descartes and Comte. Since these two philosophers have been driven by their investigations "to proclaim the unity of intelligence and the unity of knowledge, it will be demonstrated that all true instruction must be integral, and that we ought to abstain from dividing and parcelling out what nature has made one and indivisible."

Integral Education should thus be marked by unity of aim or purpose, and should be coherent on all its parts taken together, and each of the parts taken separately. Its ideal would be a knowledge that is universal in its content and universal in its application; that is to say, it should include all knowledge, and this knowledge should be so communicated that it makes the same appeal to all minds. It must be universal in the full sense of that term.

Integral Education is neither an intensive and encyclopaedic culture, nor an artificial selection of minds and a drainage of the intellectual capital of a country, but the methodical development of all the powers or faculties of the human soul by means of the universality of the sciences, classified and arranged in a hierarchy in view of their didactic use."

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SECTION OF ENGINEERING AND METALLURGICAL.

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Abstracts

1. Liquid-Liquid Extraction in a Sieve Plate Tower.

S. K. GHOSH *and* S. K. NANDI, Bangalore.

A study has been made of the extraction rate, hold up and possible throughout in the extraction of Acetone from water by Benzene in a 2″ diameter perforated plate tower. The tower is made of glass tubes fitted with flanges at both ends in between which nine perforated plates were fixed. The extraction rate and hold up are found to be increasing with the increase in the dispersed phase flow rate, but continuous phase flow rate has practically no effect on them. Study of the concentration effect on extraction coefficient 'K_Da' has shown the effect to be negligible. The H.T.U.)$_{OD}$ is calculated from the extraction coefficient for each reading and is found to be constant with the variation of both phase flow rate. By sampling the liquids above and below each plate an operating line, showing the change in the concentration of Acetone throughout the tower is obtained.

2. Synthesis of 2-Methylphenanthrene.

PASUPATI SEN GUPTA *and* BIDYUT KAMAL BHATTACHARYYA, Jadavpur.

Ethyl m-methyl cyclohenylidine cyanacetate is condensed with benzyl chloride in presence of sodium ethoxide to yield ethyl α-cyano-α-(3-methyl-cyclohex-6-enyl) -β-phenyl propionate which on cyclisation followed by hydrolysis and dehydrogenation furnishes a product identified as 2 methylphenanthrene through its picrate.

2-methylphenanthrene is necessary for our investigation on Friedel-Craft's Reaction (*Science and Culture, 12*, 410, 1947; *114*, 40, 1948). Although there are different methods for its synthesis, the above compound was synthesised according to the method of Ganguli(ibid, *ibid,7*, 319, 1941-42) along the following line.

Ethyl m-methylcyclohexylidene cyanacetate was condensed with benzyl chloride according to the condition of cope etal (*J.Am. Chem. Soc. 60*, 2903, 1938) to yield (I) which on cyclisation by concentrated sulphuric acid followed by hydrolysis and esterification furnished 2-methyl-10-carbomethoxy- 1,2,3,4,9,10,11,12 -octahydrophenanthrene (II, R=Mc). The above ester on hydrolysis gave a gummy acid (II, R=H) which was dehydrogenated by selenium. The product thus obtained furnished a picrate (M.P. 117-18°5, literature records 118-119°, Howarth J.C.S. 1125, 1133, 1932).

3. Interference to Telephone Trunk Lines due to Ripples of Rotary Convertor supplying current to trolley wires of Electric Railways.

H. N. SHRIVASTAVA, New Delhi.

Humming noise is present on the Bombay-Poona trunk lines. An analysis of the noise by the use of resonating circuits showed that the disturbance noise consisted of 300 to 450 cycles per second. Experiments were carried out to find out if D.C. supply for traction contained these interfering frequencies.

The method employed was to connect between the D.C. bus bar and ground wire connected to rails a condenser and high resistance in series. A part of the resistance was tapped and connected to noise analyser the other side of which was connected to a valve voltmeter.

Experiments gave the following results:—

Metro Vicks Rotary Converters	
300 cycles	7.5 volts
1500 „	0.0 volts
English Electric Rotary Converters	
300 cycles	11.0 volts
450 „	1.7 volts
1200 „	1.6 volts
B.T.H. *Rotary Converters*	
300 cycles	25.0 volts
1800 „	1.0 volt.

D.C. voltage varied from 1540 to 1500 from no load to about 1600 amps load.

As more railways are being electrified in the country, it is necessary that Mercury Arc rectifiers should not be obtained without resonating shunts and Rotary Converters should have the minium of harmonics or commutator ripples to prevent interference to communication circuits.

4. Design of an Artifical Network for use with 3-channel carrier on Open Wire System.

H. N. Shrivastava *and* V. Arunachalam, New Delhi.

The necessity for an artificial line network for use with carrier equipment when it is tested in the latoratory or used for demonstration purposes is obvious. Such a line network should have the characteristic impedance and attenuation characteristics of a standard open wire construction. A balanced symmetrical lattice network has been developed and used with two resistance pads. The formula for the propagation constant and the attenuation in decibals for the lattice network has been given. Experimental data have also been given showing the measured loss through the artificial line in decibals and also the loss in a 160 miles of copper trunk in decibals for comparison. The measured loss agrees well with the loss on the open wire line.

5. Localisation of Insulated Break on Communication Lines by Attenuation Tests.

H. N. Shrivastava *and* B. C. Shamamayya, New Delhi.

An insulated break fault on a line is located from the testing office either by bridge tests or by the capacity throw tests. A new method of locating the break by noting the transmission loss to the fault and the difference between the level of the loss reading has been worked out. The theory of the tests has been discussed. The new method has given good results.

6. Periodic Fading of Radio Signals and Vertical Movement of Ionosperic Layers.

S. S. Banerjee, G. C. Mukherjee *and* R. N. Singh, Banaras.

It has been found from our observations on fading of short-wave radio signals that periodic variation of intensity of the signal may occur due to two different reasons. Firstly, it may be caused by interference of two waves, singly and doubly reflected, from the same ionospheric layer, or by two singly reflected waves from two different layers. The second type of periodic fading may be caused by interference of ordinary and extra-ordinary components of the wave due to mageto-ionic splitting. The iono-

speric conditions necessary for the above two types of periodic fading are quite distinct from each other. For instance, the first type necessitates high electronic density in the ionospheric layer associated with vertical movement of the layer, whereas the second type is obtained with low electronic density when it is in the state of transition. For the above reasons the second type of periodic fading is generally obtained during the morning and evening hours. Both the above types of periodic fading have been recorded by us and the required conditions of the ionosphere stated above, have been verified from the Ionospheric data supplied by the Research Department, All India Radio, Delhi. It has been further shown that from such observations of periodic fading patterns it is possible to measure the rate of fairly slow vertical movement of the ionospheric layers and also that they may be of great use in predicting the suitability of frequency to be employed for establishing radio communication between two stations.

7. Intensity of Radio Signals in the Neighbourhood of Maximum Usable Frequency.

S. S. BANERJEE *and* R. N. SINGH, Banaras.

The reception of radio signal ceases when the frequency of transmission happens to be higher than the maximum usable frequency between the transmitting and receiving stations or when the electronic density in the ionosphere is lowered till the above condition is reached. It is usually observed however that before the signal actually disappears due to scarcity of electrons in the ionospheric layer, interference occurs between ordinary and extraordinary components of the wave due to magneto-ionic splitting which produces periodic fading of the received signal and its intensity increases prior to its cessation. It is the purpose of the present paper to show that the above enhancement of signal intensity may be attributed to the thickness of ionospheric layer. The increase of intensity however may be caused in two different ways. Firstly, the thickness of the layer gives rise to Pedersen ray which becomes more pronounced towards the end of the signal as the absorption of the wave decreases due to diminution of its path travelled through the inosphere, and consequently, the intensity of signal increases. Secondly, it can be shown that for thick inospheric layer, near the limiting angle of incidence for reception of the wave, the rays incident at an angle slightly lower or higher than this critical angle will be reflected back to the earth at the same distance from the transmitter. Thus there will be a narrow range of angle within which the incident rays at the ionosphere, as radiated from a transmitting aerial, will be reflected back approximately to the same spot on the earth and increase the intensity of received signal.

8. Effect of the Variation of Thickness of Ionospheric Layer on the Magneto-ionic Fading of Radio Signals.

S. S. BANERJEE *and* R. N. SINGH, Banaras.

This paper describes the several types of frequency and amplitude variations of periodic fading patterns of radio signals caused by magneto-ionic splitting. It has been shown that the variation of electronic density in the ionosphere, which is one of the necessary conditions for formation of such fading of signals, is inadequate for explaining all the types of variations observed in fading patterns. The complexity in the nature of fading however may be attributed to the alterations of thickness of the ionospheric layer, which give rise to different path-lengths travelled by the radio waves through the ionosphere and change the shape of fading pattern. Calculations for the above variations of periodic fading have been made for transmissions from Delhi for which observations have been recorded on various short wave lengths. It has been found that comparatively thin ionospheric layers will produce greater amplitude variations in the fading of signal and on such occassions the type of fading may be more complicated due to longer duration of the presence of Pedersen ray, in addition to the two magneto-ionic split components of the wave which cause the periodic pattern. If, however, the thickness of layer be large, the frequency of the periodic pattern will be quicker and the intensity lowered. Based on the above considerations various types of frequency and amplitude variations in the periodic pattern of fading, observed during different hours of the day, could be explained. Incidentally it may be mentioned that the effect of magnetic field at the ionosphere on such fadings has also been discussed, and it has been shown that higher

magnetic field will reduce the duration of the presence of upper extra-ordinary ray along with the Pedersen ray and hence the pattern is likely to be less complicated. This may explain the difference in fading patterns obtained at places situated at different latitudes.

9. Predicted and Observed Values of Electronic Densities in the Ionosphere.

S. S. Banerjee, R. N. Singh *and* R. R. Mehrotra, Banaras.

Graphs have been drawn to indicate the predicted and experimentally observed values of electronic densities and their variations in the F_2-region of the ionosphere. For calculation of the above, monthly noon maximum ionization has been considered, the values of which were obtained from ionospheric data recorded by the Research Department, All India Radio, Delhi, for more than two and half years, beginning from December 1945 to June 1948. In the above data, predictions of electronic densities were made for comparatively long range of three months. The periods of maximum deviation in the predicted values from the observed ones have been found to occur generally during the months of March to June in 1947 and 1948, when the error has been, some times as high as 80 percent. Analyses of the observations show that the discrepancy is more frequent and pronounced towards positive direction. The results obtained further indicate that short period prediction of electronic densities is more useful for practical radio communications and weekly observarions of the sunspot (calcium flocculi) numbers should be taken into account for such predictions of electronic densities. The importance of such analyses lie in day to day prediction of inospheric conditions which are of great value for maintaining continuous radio service between two distant stations.

10. Improvements in Building Construction and other Structures.

P. B. Ghosh, Sibpur.

The paper deals with improvements in Building Construction from the point of view of lightening the dead weight of the structure, economy of space, thermal insulation and acoustics, and reduction of cost of construction and the time needed for erection. It also relates to economy and facilities of construction of other structures such as boundary walls, retaining walls, cofferdams, steining of wells, and the like. The process is also an aid to prefabricated construction.

The method of construction is based on the invention of blocks for building purposes, or for construction of structures of masonry, or the like, which are solid blocks (without cavities or hollows passing therethrough) but are provided with projections or arms to assist in bonding and for the purpose of enabling the structures to be produced with hollows or cavities in them. The blocks can also be used for producing solid walls which will be stronger and more economical than those obtained by ordinary conventional parallel piped bricks. They can be moulded, dried and burnt like ordinary bricks, and require less amount of coal for burning them, and the time of moulding and burning the blocks is reduced.

11. Administration, a Science for Engineers.

J. N. Basu, Jadavpur.

During the last 70 years, along with the growth of industrial concerns, the principles of administration have been framed on established facts and a science is developed out of them; since science is nothing but accumulated or accepted knowledge which has been systematised and formulated with reference to discovery of general truths or operations of general laws. Knowledge of engineering & technology is a vital requirement in various phases and elements of administration; so engineers and men of technology are not only to play an important role in administration; but are to contribute greatly to the advancement of the science of management specially by way of research, design, patent, planning, economic production, industrial layout and the like. Along with the growth of

science of management, it was found necessary to acquaint persons with the science who intend to work in industrial concerns. Engineers, technicians & technologists without the rudimentary knowledge of administration-science, were found extremely unsuitable to serve any industrial firm. Consequently the science of administration was included not only into the curriculum of commerce Colleges but also into the courses of studies of Colleges and Universities for Engineering & Technology, throughout the whole world.

A table has been prepared with reference to the studies of the subjects for students of Engineering & Technology in the nine colleges in U.S.A., in six colleges in U.K., in seven colleges in Germany, five colleges in India and one college in Switzerland and at the end one Technical School of Engineering in Germany. From this table it will be found that this subject is taught in the 3rd and 4th year classes of the Engineering Colleges. The different names by which this subject is called at different Universities are also mentioned. This subject is made compulsory for mechanical Engineering course almost in all colleges, throughout the world. U.S.A. being the pioneer to evolve this science, has gone further to introduce this science, in the form of a course entittled "Business and Engineering administration" in M.I.T. and "Industrial Engineering Administration" in Cornell University, and "business administration" in the Harvard University lasting four years leading to the degree of S.B. and with further study of the subject granting S.M. & PH.D., thereby the subject is brought up to the same standard as courses of Mechanical Engineering, Naval Engineering, Electrical Engineering, Chemical Engineering and the like. In Germany, Munich & Berlin T.H. introduce the course. "Business administration" and "Business & Industrial Science" respectively, leading to the degree after four years of study.

In a joint Informal Meeting of the Institution of Mechanical Engineers, London with the institution of Civil Engineers & the institution of Electrical Engineers, London, held on 24th March, 1939, the subject, "The Importance of Training in Management for Engineers" was discussed. It was pointed out that devastating results arose in undertakings, both large and small, due to lack of knowledge of the elementray principles of management. The subject was so wide and so full of matter for argument that the following two points were accepted without discussion.

(1) That the fundamental principles governing sound industrial management are now sufficiently clearly defined to be teachable.

(2) That a knowledge of those principles would be of advantage to an Engineer in the pursuit of his profession.

So it can be safely stated that importance of the study of the science of administration for Engineers, is well recognised throughout the whole world. It remains stil to be observed how we in India should attach importance to this subject in the Universities and Colleges for Engineering & Technology in India. Uptil now the subject did not receive fairly satisfactory treatment in most colleges of Engineering and Technology in India. Let us hope that along with the advancement of the Engineering & Technological education in India, the science of administration will also receive more importance in the curriculum of studies for Engineering & Technological graduates.

12. Heat-Treatment of Steels without Decarburization.

R. A. P. Misra, Bombay.

The problem of decarburization in the commercial heat-treatment of steel is discussed with the undesirable effects of this phenomenon on the mechanical properties of various components. Essential requirements of a commercially successful atmosphere for heat-treatment furnaces are ennumerated. Details are given of a system of furnace atmosphere developed by the author in conjunction with Messrs. Wild Barfield Electric Ltd., of Watford, England.

The results of experiments carried out on the heat-treatment of steel samples of various compositions are given using this system of atmosphere generation. The author relates an incident which initiated this line of development and points out the importance of following up small clues in the development of Scientific and Industrial research. The theory underlying this development is discussed briefly with special relation to the CO/CO_2 equilibrium diagram and the effect of the temperature of generation on the character of the furnace atmosphere. Though no fundamentally new discovery is claimed, it is considered that the practical development of this invention marks a distinct advance in the technology of the heat-treatment of steels. The theoretical explanation advanced for the success of this system should help to provide a clear-

er understanding of the factors involved in the control of decarburization during heat-treatment, which are even now imperfectly understood by the majority of Metallurgists and Heat-Treatment Technicians in England and America.

Finally a plea is made for the encouragement of Industrial Research by the industrial units concerned as the author feels that only development along this line can help to improve the quality of Indian manufactured goods!

13. Wear in Producer-gas Converted Petrol Vehicle Engines.

L. C. VERMAN, MOHAN LAL KHANNA, S. K. DAS GUPTA *and* K. A. NAIR, Delhi.

A new Lease-Lend 160" wheelbase 3-ton 1943 model Chevrolet truck fitted with a modified "Simpson" gas plant and used for the various departmental road trials had completed 9,000 miles of run mostly on producer-gas. Rectified spirit and a little petrol were also used as fuel. The crankcase oils, after every 2,000 miles of run, had been analysed. The data collected has been utilized to determine the wear caused in the petrol vehicle engine, when converted to operate on producer gas under Indian road conditions. The wear observed has been compared with that observed by Bowden and Kennedy working in Australia, using Chevrolet, Ford V8 and Bedford trucks and operating on producer gas using charcoal as fuel.

It has been shown that if the gas plant is maintained to satisfy the Indian specifications, there is no excessive wear on gas as compared to that on petrol. The pressence of large amounts of fine sand in the sludge shows that it will pay to give more attention to air cleaning to keep out atmospheric dust from the engine.

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H. K. MITRA, Jamshedpur.

For the manufacture of firebrick, plastic fireclay is an essential requirement. If the Pyrometric Cone Equivalent (softening point) of the plastic clay is not high, the physical properties of the resultant firebrick are impaired. To obviate this difficulty, a technique has been developed for manufacturing firebrick entirely from non-plastic Fireclays. The brick thus made meet High Heat Duty Specification and it is not beyond the realm of possibility to make even Super Duty Firebricks by this process.

15. A Study of Coarse Filtering Media for Portable Producer-gas Plant Filters.

S. K. DAS GUPTA *and* MOHAN LAL KHANNA, Delhi.

The materials most frequently used as coarse filtering media in the first two stages of gas filtration of a portable producer gas plant in India are cotton waste, jute, sisal, coir and munj. The suitability of these materials in these filters has been investigated by studying the flow characteristics of air through these materials. Using a linear filter, a study of the pressure drop across the filter bed in relation to air velocity with different packing densities and packing depths was made. The pore size of charcoal dust particles passing through the filter bed at maximum packing density and different depths of packing in the five materials has been determined.

Using these materials in a radial filter, the pressure drop at various air velocities at maximum packing density has been determined.

The data collected so far helps one to choose the material most suitable for the first and second stages of gas filtration and in the efficient designing of the radial filters most commonly used in India with a tolerable pressure drop.

16. Scope of Dry Cyclones in Producer-gas Filtration.

S. K. DASGUPTA *and* MOHAN LAL KHANNA, Delhi.

The possibility of the use of dry cyclones in portable producer-gas plant has been investigated. Two cyclone filters, one for high and the other for low rate of gas flow

and to arrest dust particles of size 5 microns and over, were designed and constructed in these laboratories. The relationships between pressure drop and flow, between the mean diameter of particles and the percentage dust collected and between the percentage dust collecting efficiency and the flow in the case of both these filters have been studied. Bench tests with these two filters when replacing the initial filters of a mobile producer-gas plant were carried out. Though these cyclones filters could not replace all the three filters of a portable producer-gas plant, yet it was possible to replace some of the existing types of filters used in the initial stages of gas filtration.

17. Investigations on Colorimetric Methods of Metallurgical Analysis. Part VIII. Estimation of Silicon in Steel, employing the Duboseq type of Colorimeter.

G. V. L. N. Murty *and* N. C. Sen

A procedure has been described for the colorimetric estimation of silicon in steel by employing the Duboscq type of colorimeters. This is shown to be capable of yielding reprodicible results, comparable in regard to their accuracy, with those obtained by absorptiometric and gravimetric methods. It is clear from the data embodied in this paper that the visual procedure now suggested could be conveniently employed for the analysis of steels covering a wide range of variety, both in regard to the number and nature of the constituent elements present and their percentage concentration.

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